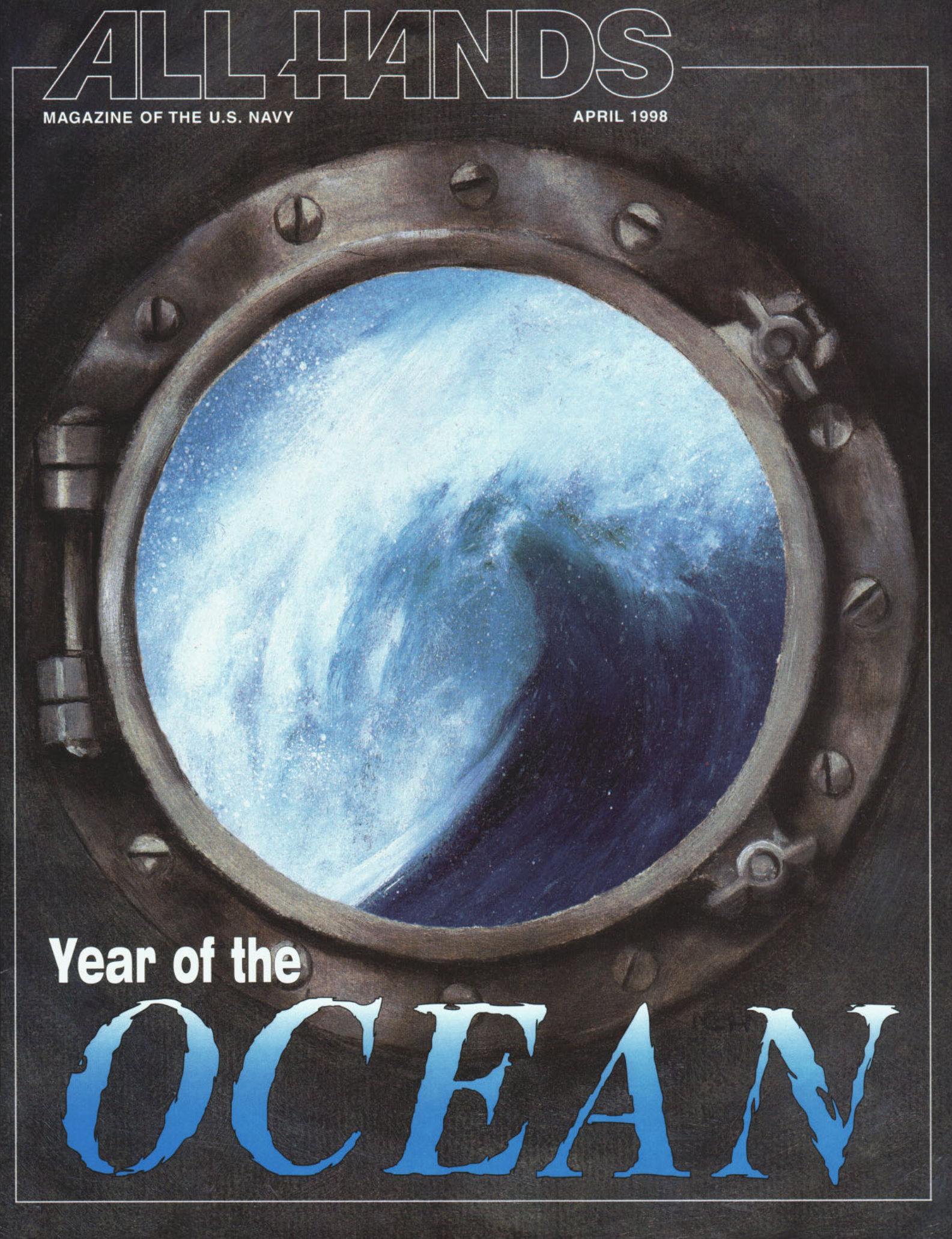
ALL HANDS

MAGAZINE OF THE U.S. NAVY

APRIL 1998



Year of the OCEAN

ALL HANDS
April
Number 972

Features

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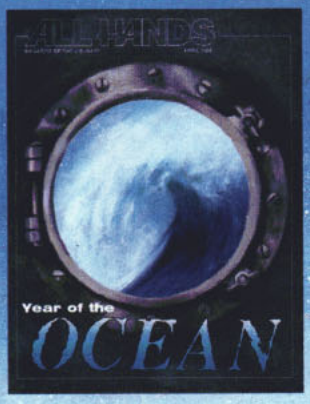
On the Cover

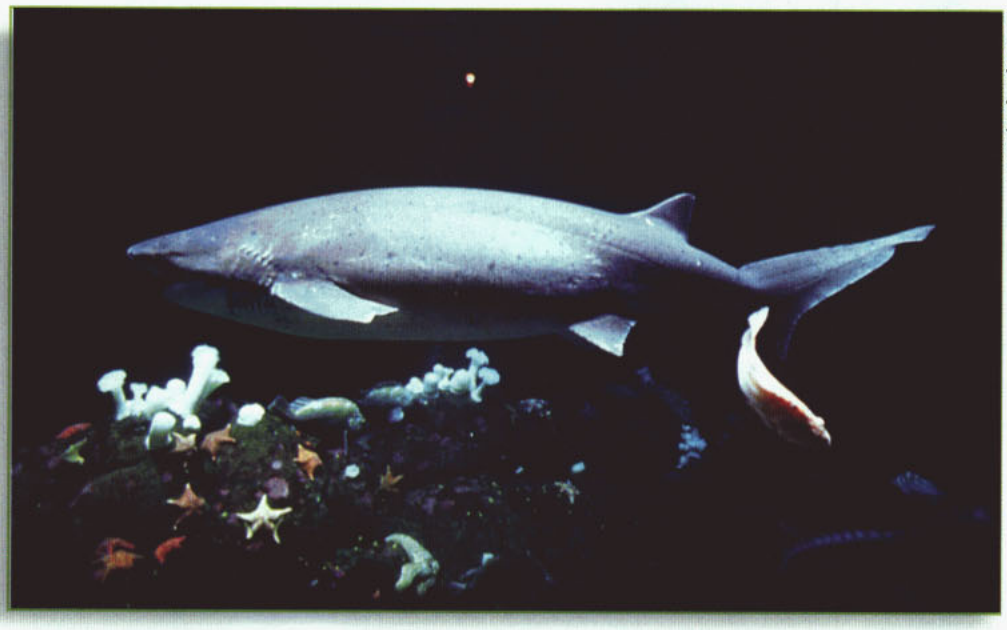


The ocean's resources are finite. Each of us has a responsibility to manage these vital resources wisely and carefully so future generations can use and enjoy them. You have the power. You can make a difference. Art by DMSN Michael Noeth

Exploration

The Navy:

Monterey Bay Aquarium



Monterey Bay Aquarium

Monterey Bay Aquarium

Monterey Bay Aquarium

The Audobon Institute

Year of the Ocean

Monterey Bay Aquarium

Monterey Bay Aquarium

"For 222 years, Americans have used the world's oceans as a vehicle for supporting peace and security in the world. That's where the Navy-Marine Corps Team spends its time. Our Sailors and Marines have a very healthy appreciation of the oceans, but we all must become aware of just how precious the oceans are to us.

The Navy-Marine Corps team has shown true global leadership in pollution prevention, waste management, national and international regulations, and conducting ourselves as good stewards of the environment and our oceans. We continue to find new ways to use today's technology to protect our oceans.

Our oceans are a precious resource that we must constantly strive to preserve.

I want to reemphasize my own commitment to the Year of the Ocean.

The Navy-Marine Corps Team recognizes that the ocean is where we do our business, where we train and where we ensure that we are ready. We can do no less than take good care of 'our' oceans!"

—Secretary of the Navy John H. Dalton

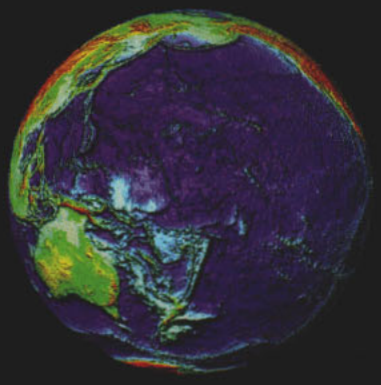
oceans 101

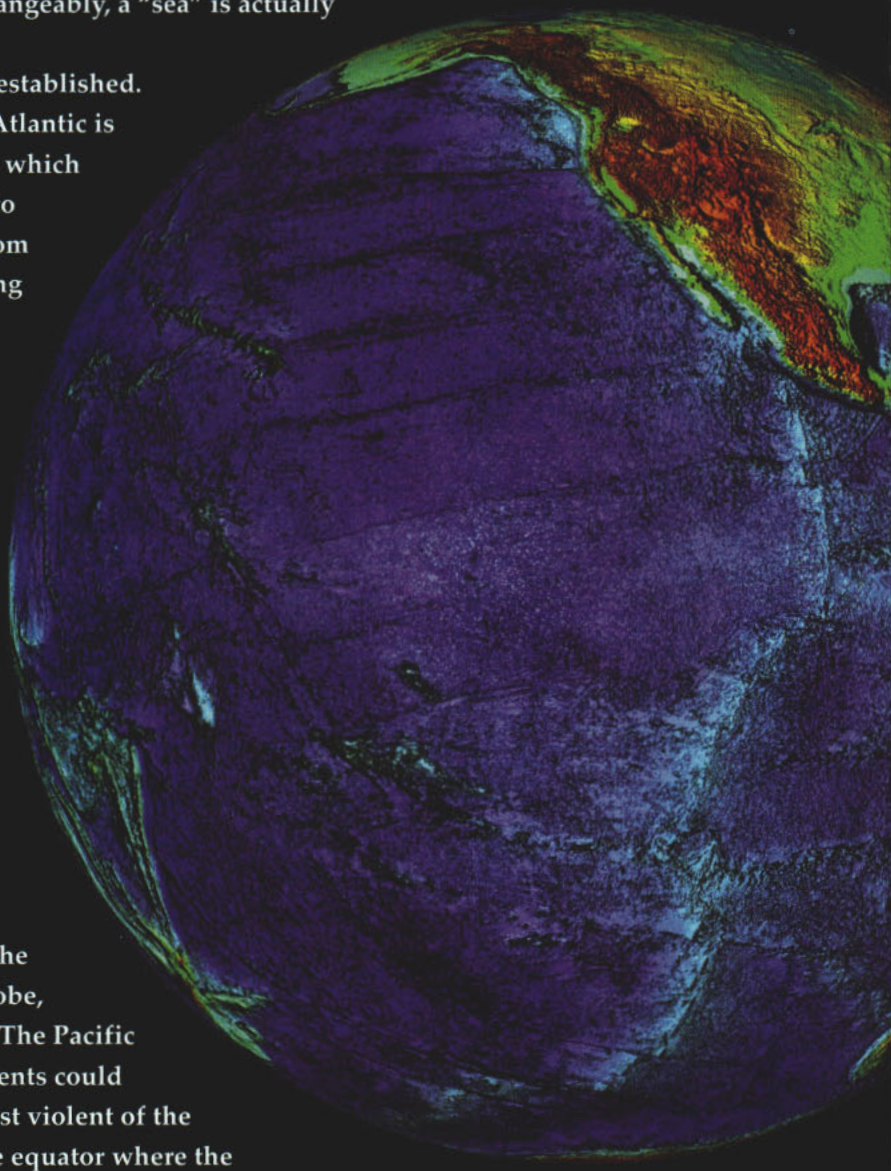
Our oceans are the source of infinite energy, splendid beauty and unparalleled mystery. Although much is known about this world beneath the waves, so much more is still waiting to be discovered. With more than 70 percent of the world's surface covered by water, the Earth's oceans remain an immense frontier for exploration. For more than 200 years, the U.S. Navy has sailed these oceans in defense of freedom. Every Sailor should understand this incredibly vast, sometimes fragile and always remarkable marine environment.

The Four Oceans

The four oceans of the world are the Atlantic, Pacific, Indian and Arctic. While "ocean" and "sea" are often used interchangeably, a "sea" is actually a subdivision of an ocean. There are 54 seas.

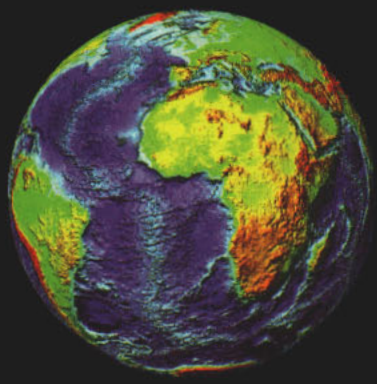
Boundaries between oceans were arbitrarily established. For example, in the Southern Hemisphere, the Atlantic is separated from the Pacific by an imaginary line which extends from Cape Horn across Drake Passage to Antarctica. Similarly, the Pacific is separated from the Indian Ocean by a string of islands extending from the Strait of Malacca to Australia, and southward from Tasmania to Antarctica.





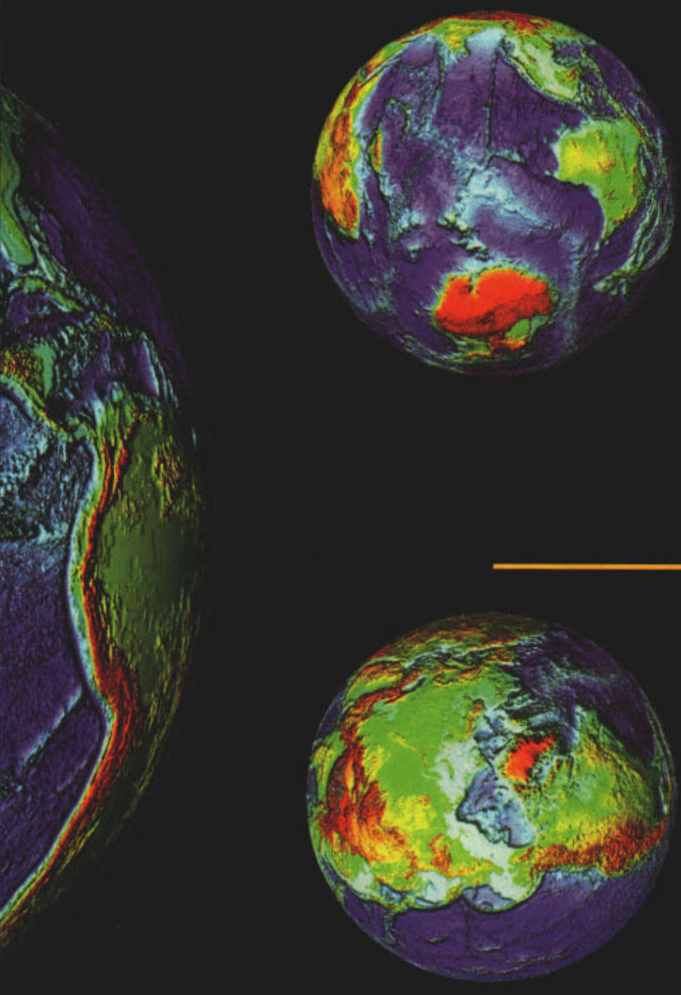
Pacific Ocean

The Pacific is by far the largest and deepest of the four oceans. It covers nearly one-third of the globe, an area approximately 64 million square miles. The Pacific Ocean is so immense that all the world's continents could be put into it with room to spare. Likely the most violent of the oceans, the Pacific is home to typhoons near the equator where the ocean measures nearly 11,000 miles wide. It is also home to more than 300 active volcanoes and periodic tidal waves. The Pacific has an average depth of 13,000 feet.



Atlantic Ocean

The hourglass-shaped Atlantic covers approximately 20 percent of the Earth's surface and is the second largest of the four oceans. It extends from the North Pole southward for 10,000 miles to the Antarctic continent, and covers 41 million square miles. More is known about the Atlantic because of the heavy commercial and military ship traffic connecting Europe and North America. The Atlantic's average depth is 12,000 feet and the greatest depth is 28,374 feet in the Puerto Rico Trench. If Alaska's Mount McKinley (20,320 feet) was to rise from the floor of the Puerto Rico trench, its peak would still be about 1.5 miles below the surface of the Atlantic.



Indian Ocean

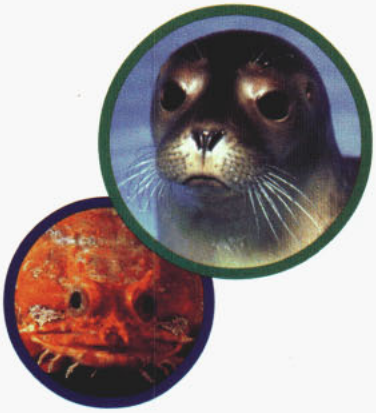
The Indian Ocean is often incorrectly thought of as a tropical ocean. Check your map! It stretches southward to Antarctica. It is triangular and bordered by Africa, Asia, Antarctica and Australia. Although it covers about 28.5 million square miles, it is smaller than the Atlantic and less than half the size of the Pacific Ocean. The Indian Ocean contains only 20 percent of the Earth's water surface, but many island nations are found within its boundaries - Madagascar, which is the world's fourth largest island, the Seychelles, Maldives, Mauritius and Sri Lanka.

Arctic Ocean

Centered approximately on the North Pole, it is the smallest of the world's oceans, covering about four and a half square miles. This ocean's maximum depth is 18,050 feet. The ocean is divided into two nearly equal basins: The Eurasia and the Amerasia. The Lomonosov Ridge, which extends from northeastern Greenland to Central Siberia, separates the basins. The Arctic Ocean is surrounded by the land masses of Eurasia, North America and Greenland, and is unlike the other three oceans because of its perennial ice cover. The extent of ice cover is seasonal between 60N and 75N latitude, but above 75N it is relatively permanent. Ice cover reduces energy exchange with the atmosphere which results in reduced precipitation and cold temperatures.

Seawater vs. Freshwater

Only 3 percent of the Earth's water is fresh, the rest is salty. Two-thirds of the Earth's fresh water supply is frozen solid in ice caps and glaciers. The remaining 1 percent is found in clouds, precipitation (rain and snow), rivers, lakes and ground water. Seawater, or saltwater, is a complex solution made up of trace amounts of nearly 60 different chemical elements, including gold. In fact, if all the gold in the world's oceans could be mined there would be enough to supply every person on Earth with nine pounds each. But, common salt is the most abundant ingredient, making up approximately 78 percent of the total dissolved solids in seawater. It has been calculated that if all the oceans of the world would dry up, 4.4 million cubic miles of salt would remain. That's enough salt to cover all land on the planet to a depth of 150 feet.



Seawater Salinity

The first thing that comes to mind about seawater is that it is salty. Salt content, or salinity, is the total amount of dissolved solids contained in one kilogram of seawater. In that there are 1,000 grams in a kilogram, salinity is numerically expressed in parts per thousand (ppt). Salinity in the oceans varies from about 32 to 37 ppt except in the polar regions and near shore where it may be less than 30 ppt. The average salinity of the world's oceans is 35 ppt, which is the same as 35 grams of salt in each kilogram of water.

Icebergs

Glaciers create icebergs when large chunks of the glacier break off (calving) and begin to drift. Approximately 7,500 icebergs are formed during this process each year. Portions of an iceberg may have hues of blue or green, depending upon the age of the ice. Blue ice is "old," while green ice, which contains algae, is considered "new." Glaciers on the west coast of Greenland produce most of the icebergs found in the Northern Hemisphere. Icebergs vary in size, but are typically irregular with pinnacles. About seven-eighths of an iceberg is submerged. Thus, iceberg drift is affected more by ocean currents than by wind. When they drift into shipping lanes, they become a serious hazard.

All seven species of barracuda live in American waters. The great barracuda, often called "the tiger of the seas" feeds on other fish but will attack people.

Seawater Pressure

A major problem with working at great depths is the tremendous weight of water. Oceans, like the atmosphere, exert pressure on the surface upon which they rest. For example, a 1-inch by 1-inch column of atmosphere resting the Earth's surface weighs approximately 15 pounds (actually 14.7). This number, when used in calculations, is referred to as "one atmosphere" or 14.7 pounds per square inch. Pressure in the ocean increases one atmosphere with about every 33 feet of depth. For example, at a depth of 99 feet, the absolute pressure would be about four atmospheres, or four times greater than on the surface. In the Puerto Rico Trench mentioned earlier (28,374 feet deep), pressure would be more than 12,642 pounds per square inch or the equivalent of about 860 atmospheres.

A hyperbaric chamber can keep divers from getting the bends.

Underwater Sound

Light and radio waves are highly absorbed by the oceans, but sound waves are not. This is why sound waves are used to probe and measure the oceans' depth, evaluate bottom sediment thickness and communicate underwater. The speed that sound travels underwater varies from about 4,750 to 5,150 feet per second. It increases with temperature at a rate of about 7 feet per second per degree Fahrenheit; it increases with salinity at about 4 feet per second per 1 ppt increase in salinity; and it increases 1 foot per second for every 60 feet of depth.

The Restless Sea

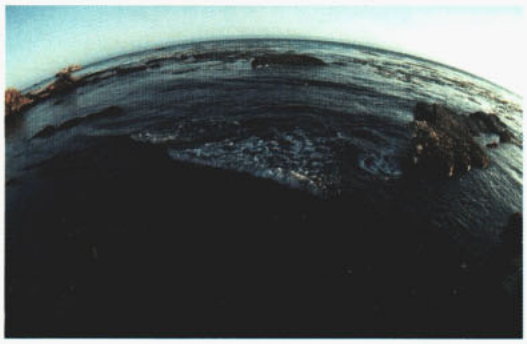
The sun's energy drives the oceans' circulation patterns. Rising warm air, sinking cold air and uneven heating of the Earth's surface create wind, which is the major force behind all horizontal surface currents. Other forces also effect the movement of the sea. The gravitational pull of the sun and moon, for example, has a particularly profound influence on coastal waters where tidal ranges are large. Whatever force is driving the movement, the bottom line is that the ocean is in constant motion.

Currents

Currents are persistent global water motions that transport large volumes of surface and subsurface water across vast distances. They may be horizontal or vertical, depending on the forcing mechanism. Horizontal surface currents are propelled by the frictional force of wind dragging the water. Because the wind directly influences currents in the surface-layer circulations of the ocean, there is a relationship between oceanic circulation and the general circulation of the atmosphere. For example, in the Northern Hemisphere oceanic circulation is clockwise and in the Southern Hemisphere it is counterclockwise. There are also subsurface currents involving the flow of deep ocean water, a process called thermohaline circulation, which arise from differences in density in seawater. These sea-surface and deep-ocean currents keep the oceans in constant motion.

Longshore Currents

Longshore currents can be found on most beaches, but their strength is seasonally variable (stronger in winter). They form when waves strike a beach at an angle. As the wave front enters shallow water, the leading edge of the wave hits the shallow water sooner than the rest of the wave front and slows down, bending the wave as it moves ashore. The shoreward movement of the wave thus forms a current whose net flow is parallel to the shore in the surf zone. The speed of the longshore current increases as the waves get larger and strike the beach with less frequency at a greater angle. The slope of the beach can also affect this current. Once established, the current moves at a speed of about one knot in the same direction as the advancing wave train. Longshore currents are more prevalent along lengthy straight coastlines. Sandbars often form in areas where longshore currents frequently occur.



Rip Currents

Longshore currents can also give rise to rip currents, often called "rip tides." Rip currents are formed when longshore currents, moving parallel to the coastline, are deflected seaward by bottom irregularities, or meet another current deflecting the flow seaward. Development depends upon wave conditions. Large incoming waves on a long, straight beach will produce "rips."

A boat is left high and dry during low tide.

Tides

Tides are the slow, periodic rise and fall of the sea surface. They are usually described as being either diurnal or semi-diurnal. Diurnal tides have one high water and one low water in each lunar day (about 24.8 hours), while semi-diurnal tides have two highs and two lows. While these tidal changes are easier to observe where land and water meet, they exist everywhere - even in the middle of the ocean! Tidal ranges along the shoreline vary by location. For example, the tides in Canada's Bay of Fundy, an Atlantic Ocean inlet west of Nova Scotia, rise and fall as much as 50 feet, while the tidal range in Lake Superior, Mich., is measured in inches.

Tidal Currents

The rise and fall of the tide is accompanied by the horizontal flow of water called a tidal current. The usual terms used to describe the direction of this horizontal movement are ebb and flood. Ebb currents occur when tidal currents are moving away from the coast. Flood currents move toward the coast. In a semi-diurnal current, the flood and ebb each last about six hours.

Waves

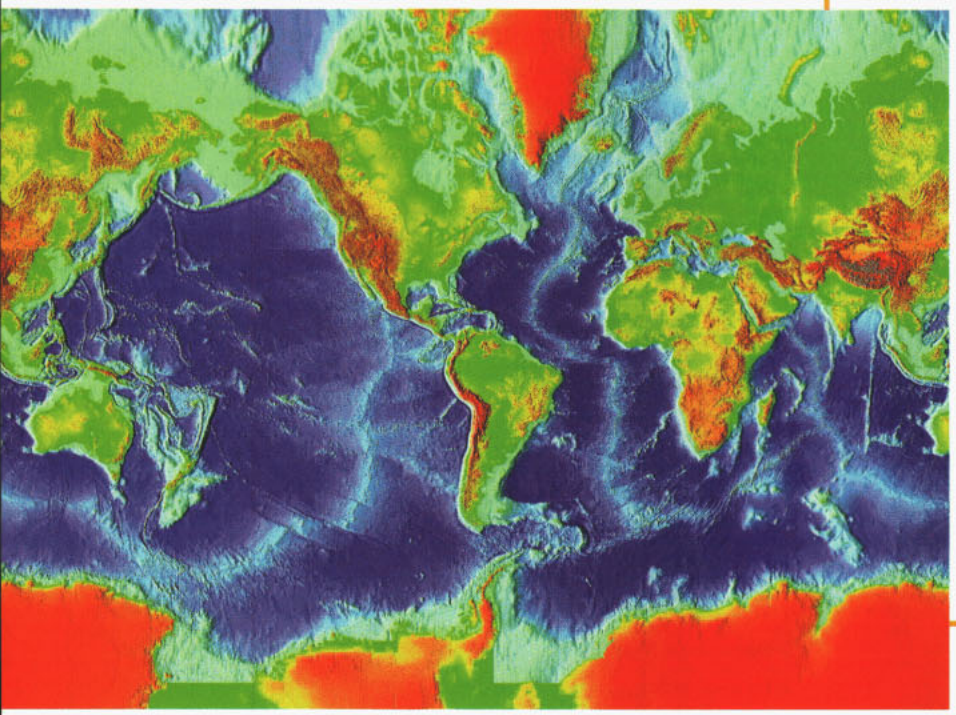
Waves are created principally by wind moving over water. Although earthquakes or landslides can also initiate wave action. Friction between a water surface and moving air piles up water in ridges that become waves. Wave height depends upon wind strength, fetch (distance wind blows over water) and duration (length of time the wind blows). Small wavelets called ripples appear when a breeze of less than 2 knots blows across a smooth water surface. Whitecaps will form on an ocean or large lake when winds reach 12 to 13 knots. White foam from breaking waves begins to blow in streaks along the direction of the wind at about 30 knots.

Tsunami waves

"Tsunami" is Japanese for "storm-wave." This term is used internationally to describe a series of ocean waves created by sudden, large scale submarine disturbances such as earthquakes, landslides or volcanic eruptions. The size of the wave depends on the nature and intensity of the underwater disturbance. The height and destructiveness of such a wave depends on the distance traveled from the epicenter, the topography of the ocean floor and the coastline.

A submarine earthquake, April 1, 1946, created a tsunami wave so large it encompassed the entire Pacific Ocean Basin. Traveling at an average speed of 425 knots, the wave reached the Hawaiian Islands in four hours and 34 minutes, with the tsunami cresting 50 feet above normal water level. A section of coast more than 1,000 feet wide was flooded. Some of the waves reached as far as Australia — 6,700 miles from the epicenter.

The Underwater World



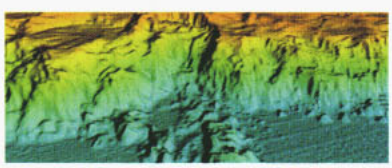
We have always known our oceans are immense. But, the introduction of the echo sounder in the early 20th century allowed us to understand just how immense. The echo sounder is a device that calculates water depth by measuring the time between the emission of a sound signal directed toward the ocean floor and the return echo. During the last 90 or so years, marine geologists and hydrographers have gathered sufficient information from echo-sounder data and bottom samples to map the ocean floor.

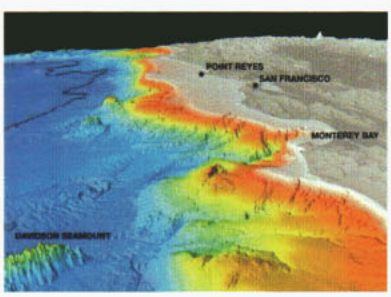
Abyssal Plains

Abyssal plains are found at the base of continental slopes, sometimes at depths greater than 9,000 feet. These plains have near freezing water temperatures and no sunlight. The Abyssal plain is regarded as the true ocean floor. The few marine inhabitants found in the region survive only because they have adapted to the hostile environment of complete darkness, bitter cold and immense pressure. Abyssal plains are among the smoothest surfaces on the planet, with less than five feet of vertical variation for every mile. These level plains are the result of a constant rain of sediments from above.

Continental Slopes and Canyons

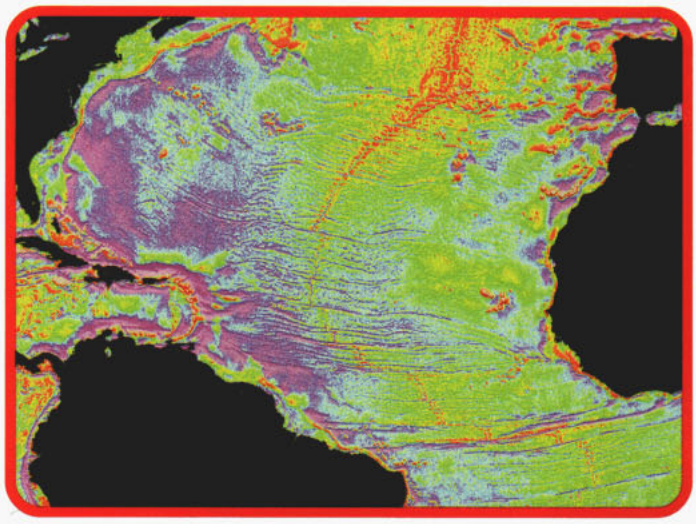
Continental slopes rise gradually from abyssal plains but can climb by as much as 45 degrees as they approach the edge of the continental shelf. In some areas, these slopes are interrupted by broad wedges of sediment deposits called continental rises. Slopes are often gouged by deep valleys or canyons, many with the same proportions as the Grand Canyon. While most canyons were originally formed during the Ice Age, some are the result of earthquakes.





Continental Shelf

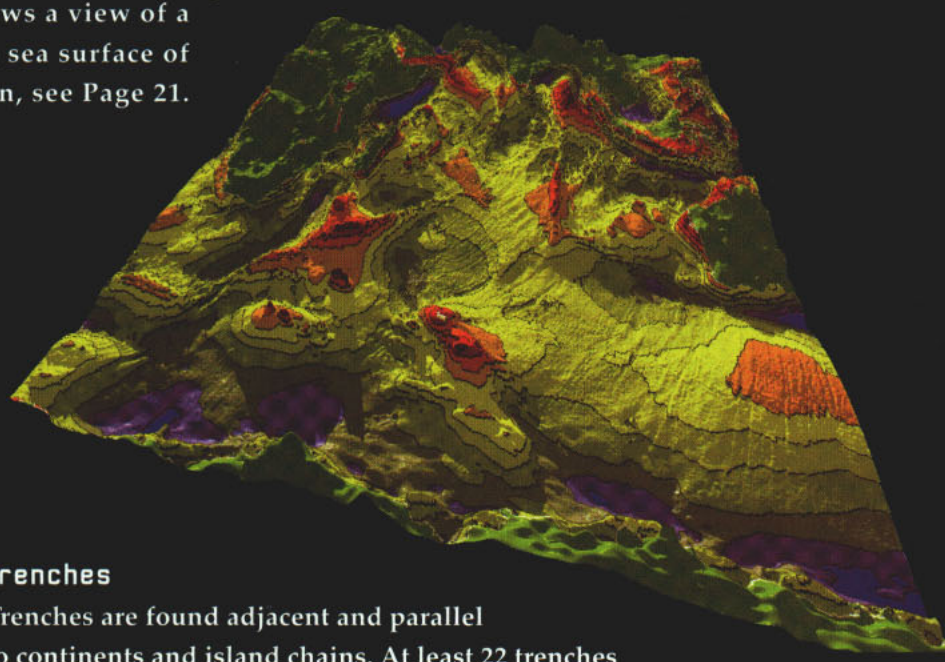
Continental shelves extend from the coastline to the edge of continental slopes. Taken together, these shelves account for about 8 percent of the sea floor area worldwide. Continental shelves are a national asset for most countries because they provide an excellent area for fishing, both commercial and sport, as well as being a resource for oil and natural gas. Shelves are not of uniform width. They vary considerably in size off the coasts of the United States alone. For example, the shelf is almost negligible along Southern California. Florida's shelf off the southeast coast is also small, especially when compared to the one extending from its west coast more than 200 miles into the Gulf of Mexico. The average width worldwide is about 40 miles.



Mid-Ocean Ridges

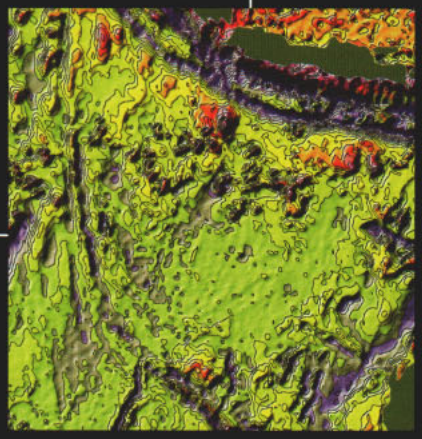
Several mid-ocean ridges are longer than the longest mountain ranges on Earth. They are also tall, with some rising to as much as 12,000 feet above the ocean floor. Often their peaks penetrate the ocean's surface to form islands, such as Iceland and the Azores in the Atlantic and the Galapagos Islands in the Pacific. Most of the ridges crest at a depth of about 8,000 feet and their widths vary from 500 to 1,500 miles. Unlike typical continental mountain ranges which have a singular pronounced line of peaks, oceanic ridges have two, separated by a prominent depression known as a rift valley. The valley ranges from 15 to 30 miles in width and cradles an active seismic belt.

This topographic image shows a view of a short wavelength part of the mean sea surface of the Indian Ocean. For more information, see Page 21.



Seamounts

Seamounts are isolated mountains rising from 3,000 to 10,000 feet above the surrounding seabed. Shaped like a cone, they have a characteristic depression similar to a crater at the summit. Samplings gathered from more than 50 seamounts around the world have led to the theory that they are of volcanic origin. Seamounts are found in all oceans, but are more numerous in the Pacific Ocean, where more than 2,000 have been identified. They are especially abundant in the Gulf of Alaska.



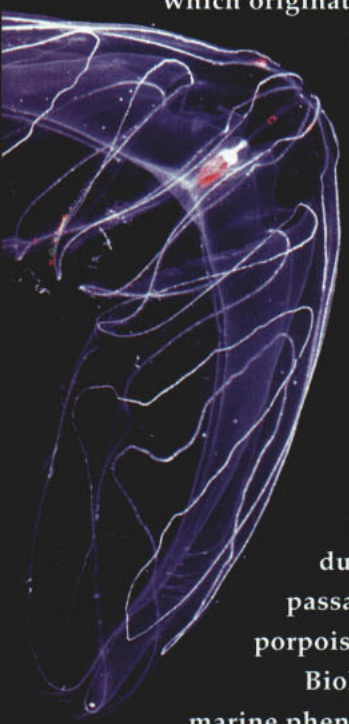
Trenches

Trenches are found adjacent and parallel to continents and island chains. At least 22 trenches have been identified although not all are classified as major. Of this number, 18 are in the Pacific, three are in the Atlantic, and one (the Java Trench) is in the Indian Ocean. Depths of major trenches exceed 18,000 feet, and vary from 10 to 22 miles in width. The deepest of these is the Challenger Deep (35,810 feet) in the Marianas Trench. The depths of many trenches are greater than the elevation of the world's highest mountain. If Mount Everest (29,028 feet) were dropped into the Challenger Deep, its peak would still be almost three miles below the surface of the ocean. Trenches are not uniform in depth or width. The Peru-Chile Trench off the west coast of South America is nearly 1,100 miles long whereas the Japan Trench measures only 150 miles.

Bioluminescence

Living Light

Story and photos by Steven Haddock

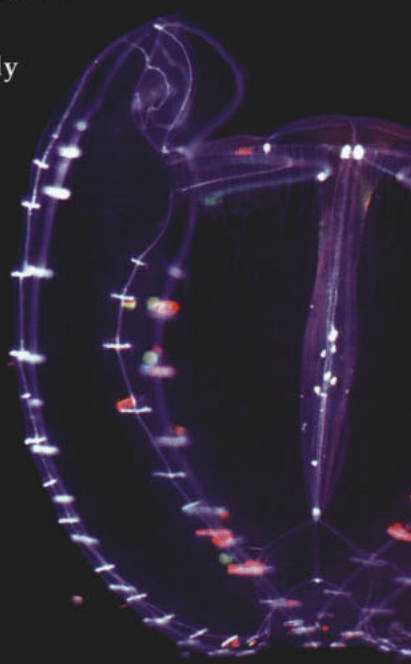


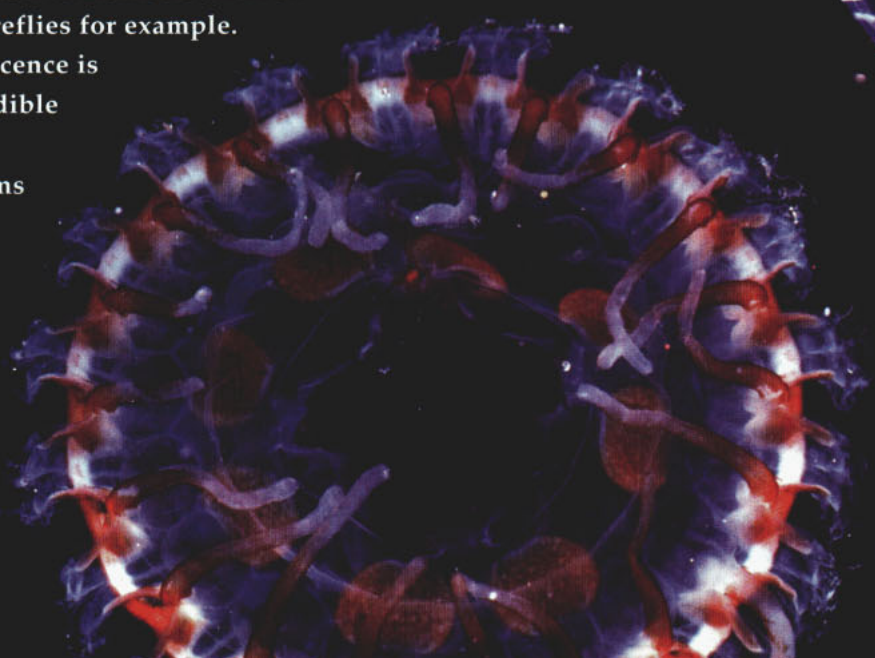
Bioluminescence is defined simply as the process wherein light is produced by a chemical reaction which originates in an organism. It can be found at anytime of the day, in any region of the world or depth of the sea. The most observable occurrence to Sailors is the often brilliantly luminescent bow wave or wake of a surface ship. In these instances, the organisms are almost always dinoflagellates, single-cell algae, numbering many hundreds per liter. When they are excited they produce light. Light production can be caused by a ship's passage or even by the movement of porpoises or smaller fish.

Bioluminescence is primarily a marine phenomenon. It is the *only* source of light in the deep ocean. In contrast, bioluminescence is essentially absent in fresh water. On land it is principally confined to members of a few families of insects, fireflies for example.

Marine bioluminescence is produced by an incredible range of bacteria and single-celled organisms to fish and squid. Some especially interesting examples are a type of squid that changes the color of its luminescence to match moonlight and sunlight, a fish with its own "night-vision" light and crustaceans that send out coded messages to their own species when its time to mate.

Bioluminescent bacteria occur nearly everywhere, and probably most spectacularly as the rare "milky sea" phenomenon. Reports of this phenomenon are abundant, particularly in the Indian Ocean where mariners report steaming for hours through a sea of glowing, soft, white light as far as the eye can see.





Myths and Fact

Myth: Bioluminescence is mostly caused by bacteria.

Fact: Bacteria can be luminous, and some organisms like fish and squid DO have bacteria in their light organs. The majority of marine life able to produce light do so with chemicals they have stored in their bodies.

Myth: Bioluminescence is the same as fluorescence, phosphorescence or chemiluminescence.

Fact: All these terms apply to the production of light from chemicals, but bioluminescence is only *similar* to chemiluminescence.

In fluorescence, the energy from an external source of light (protons) is absorbed and almost immediately re-emitted. This is how laundry detergents can get things "whiter than white," by absorbing non-visible ultraviolet light and fluorescing in the visible spectrum.

Phosphorescence is similar to fluorescence except that the excited product is more stable, so the time until the energy is released is longer, resulting in a glow after the light-source has been removed. This is the basis behind glow-in-the-dark stickers.

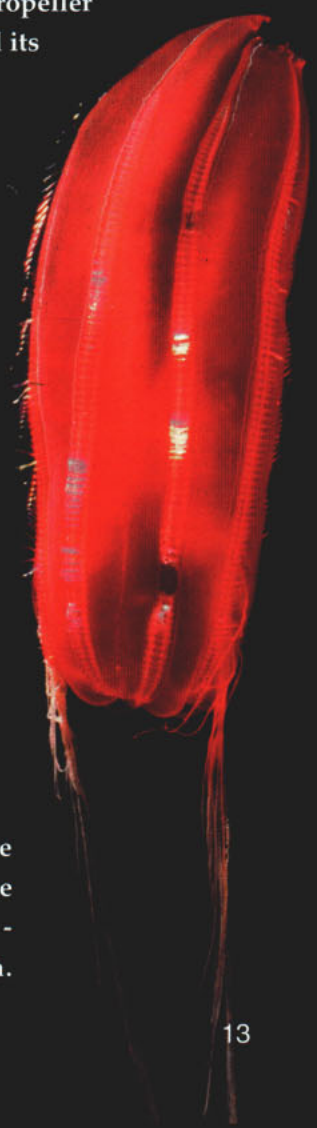
Chemiluminescence is a general term for production of light from a chemical reaction (as opposed to the absorption of photons, as in fluorescence and phosphorescence).

Bioluminescence is subset of chemiluminescence, where the light-producing chemical reaction occurs inside an organism.

Interesting Facts about Bioluminescence:

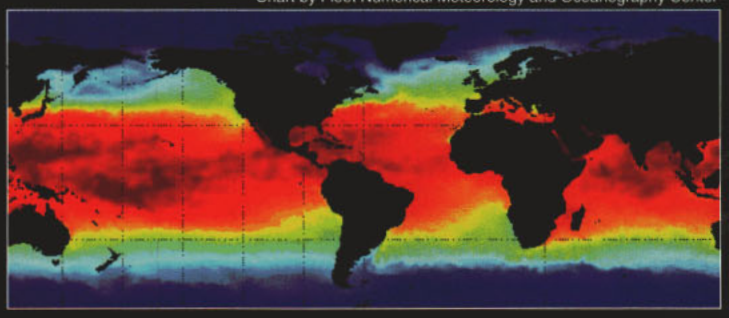
During World War I, German U-boat commanders were aware that the luminous trails created by a submarine's propeller could reveal its position and seal its fate. In fact, in November 1918, the last German U-boat sunk in the Great War was detected because of bioluminesence.

There is also documentation that carrier-based World War II aviators could easily locate their carrier after a mission by following the luminescent wake, sometimes for miles.



Haddock is a graduate student researcher at the University of California - Santa Barbara.

Chart by Fleet Numerical Meteorology and Oceanography Center



El Niño's large-scale changes of atmospheric and oceanographic conditions are now believed to influence a variety of global weather events including torrential rainfall, devastating droughts and searing heat waves. During an El Niño, westward-blowing trade winds subside and warmer water slowly moves eastward along the Equator, interrupting normal cold-water upwelling as seen in the above map. Cooler water appears blue, while warmer water looks red.

El Niño: It's Not Over

Trouble...

What's With the Weather?

Story by Cathy L. Willis Naval Meteorology and Oceanography Command Public Affairs

Its name means "The Child," in Spanish, but this winter the disruption of the ocean-atmosphere system in the tropical Pacific known as El Niño/Southern Oscillation (ENSO) promises to deliver an adult-sized wallop.

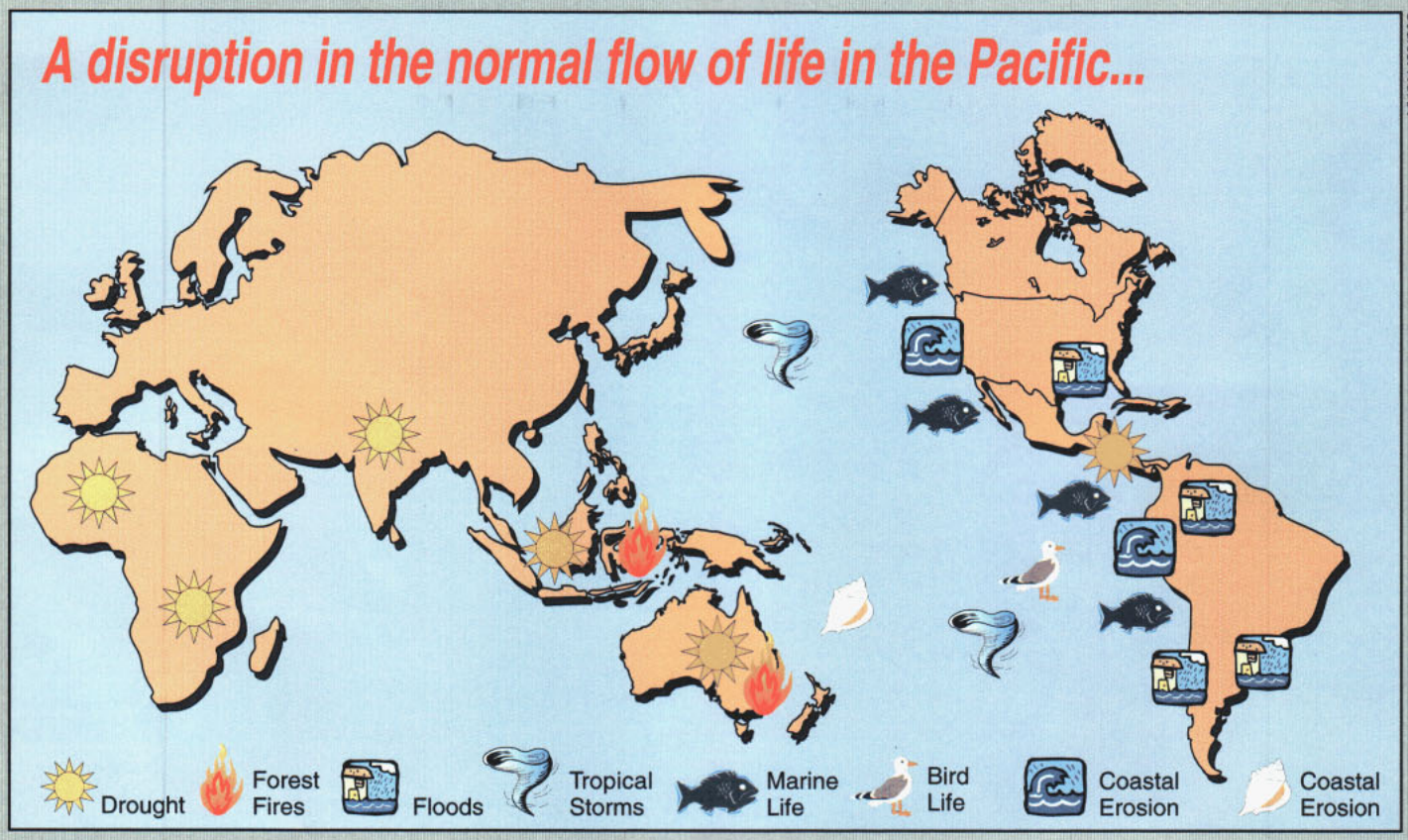
Naval meteorologists and oceanographers say this could be the biggest ENSO of this century — even bigger than the 1982 to 1983 event which reportedly cost more than $10 billion in damages worldwide.

Photo by PHC William Von Seggern

Photo courtesy of NASA

One of the hardest hit areas on board Naval Station Marianas, Guam, was the senior officer housing area. Causing more than $200 million in damage and displacing more than 2,500 people. Super Typhoon Paka had sustained winds of 175 mph with one wind gust recorded as the strongest ever recorded on Earth at 236 mph.

Every two to seven years, the trade winds in the tropical Pacific weaken. Why this happens is a subject of conjecture and scientific inquiry; but, it is known that when the winds relax, a response is triggered in the ocean which originates somewhere between the Western Pacific and the coast of South America. This response, known as an equatorially trapped Kelvin wave, produces the sea-level rise, thermocline deepening and sea surface temperature (SST)



Source: NOAA

Subtle changes in the interplay of wind and water in the tropical Pacific can affect local ecosystems and human lives in far flung regions of the globe. Some of the documented environmental impacts of the 1982 to 1983 El Niño event, the strongest thus far this century, are indicated by symbols on this global map.

warming associated with El Niño. The resulting abnormally warm SSTs in the central and eastern Pacific Ocean breed thunderstorms and affect global atmospheric circulation patterns and storm tracks.

El Niño can turn global weather topsy-turvy and produce unusual patterns of hurricanes, storms, heavy rains, floods, landslides, droughts and fire storms. The climatic effects last as long as two years and can influence areas far removed from the Pacific Ocean.

The National Oceanic and Atmospheric Administration's models of the ocean and atmosphere have been predicting an ENSO since late 1996. The system's gargantuan intensity and strength only became apparent in infrared satellite imagery gathered last summer.

"We knew when the trade winds reversed for about 10 days in June that we were going to have an unusually strong El Niño," said Michael Clancy, deputy department head of the data and models department at the Fleet Numerical Meteorology and Oceanography Center (FNMOC) in Monterey, Calif. "Currently our products are showing sea surface temperature anomalies off the coast of Peru that are 5 to 6 degrees centigrade above normal. These are some of the warmest SST anomalies recorded for these locations in 50 years," he said.

People worldwide have been tracking El Niño via FNMOC's Optimum Thermal Interpolation System (OTIS) products on the World Wide Web at *<www.fnmoc.navy.mil>*.

ENSO-related climate changes are expected to peak early next year, but associated weather oddities are already making headlines: Hurricane *Nora* pelted arid Yuma, Ariz., in late September 1997, while Hurricane *Pauline* slammed Acapulco, Mexico, in October 1997. Marlin, the trophy fish prized by sport fishermen in tropical Baja, Calif., are turning up in the normally cool Pacific Northwest. In Peru, El Niño caused heavy snowfalls in mountain passes that left hundreds of vehicles stranded and 10

people dead from exposure.

Forecasters at the Naval Pacific Meteorology and Oceanography Center (NPMOC) in Pearl Harbor, are braced for a potentially severe tropical storm season.

"Our fleet customers have requested ENSO briefings about twice a week over the last three months," said LCDR Stan Akahoshi, fleet services officer for NPMOC. "While the frequency of hurricanes in the eastern Pacific is about in line with historical averages, their overall intensities are qualitatively higher. The recent Hurricane *Linda* was the most intense hurricane ever recorded in the eastern Pacific and, at one point, was forecast to move right over southern California. Luckily, for the fleet in San Diego, *Linda* went west. This ENSO has not yet brought a hurricane to Hawaii, but two of Hawaii's strongest hurricanes, *Iwa* in 1982 and *Iniki* in 1992, took place during ENSO episodes. And *Iwa* waited until November."

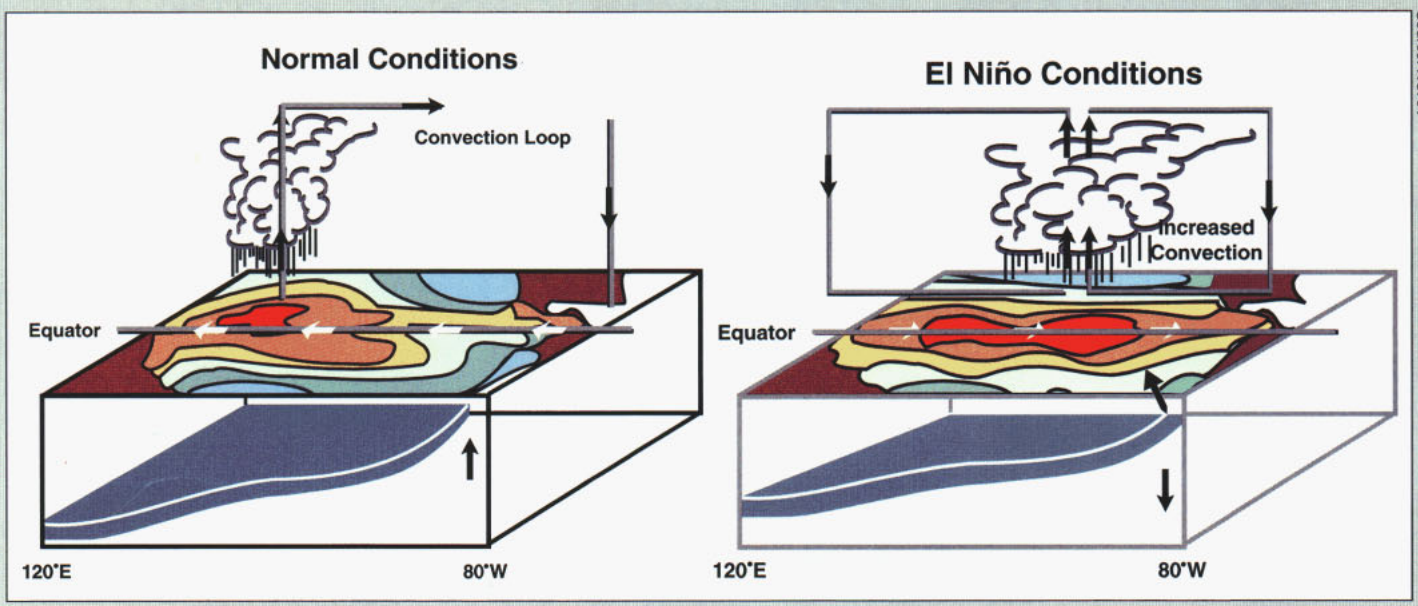
If the current ENSO runs true to model predictions, California and the entire southern United States will be in for a wet winter for 1998, while the north should enjoy mild climates. Hawaii may be looking at a severe winter drought similar to the one it experienced during the 1982 - 1983 ENSO. Some weather experts caution against predicting this El Niño's effects based on past experiences.

"We're coming off a year that had some really wild global weather patterns," said Bill Burnett, director of atmospheric programs for the Naval Meteorology and Oceanography Command. "Now we're looking at a very strong El Niño. We know that El Niño disrupts climate, but we don't know yet what effect it will have on these unusual weather patterns. No two ENSOs are exactly the same, and you can't blame all strange weather on El Niño. We'll just have to wait and see what happens."

Willis is the deputy public affairs officer for CNMOC.

Ocean Fact

Attemps to trace historic occurrences of El Niño events have suggested that a prolonged in El Niños caused the American Dust Bowl of the 1930s; that El Niño rains impeded the Lewis and Clark expedition in 1806; and that harsh European winters of the 1940s kept Hitler's armies from overrunning Russia.



Source: NOAA

Like partners engaged in an ongoing dialogue, the tropical Pacific Ocean and the overlying atmosphere influence and react to one another. Changes in the strength of the easterly surface winds along the equator induce ocean currents and upwelling, which cause changes in sea-surface temperature, thus altering the distribution of rainfall, and the strength of the easterlies and so on. ...

How many can you name?

For answers see Page 48

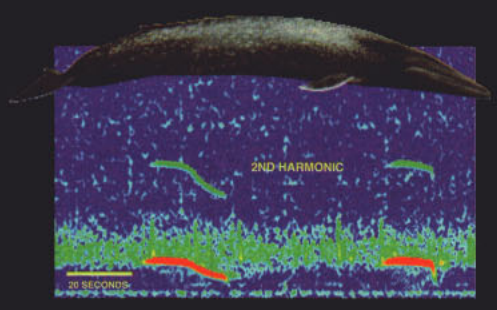
Ocean Research

Whale Song

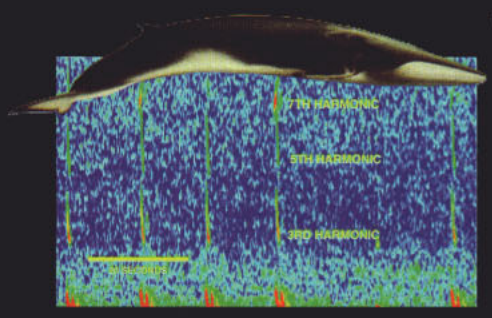
By monitoring the Integrated Undersea Surveillance System (IUSS), a network of underwater microphones designed by the Navy to detect and track submarines, scientists at the Naval Research laboratory, Washington, D.C. , have detected and recorded more whale sounds in the past five years than ever before in history!

IUSS has, in effect, opened the floodgates for whale research. Not only do scientists now have the ability to explore the entire ocean, but this technology is so advanced that it actually allows them to distinguish between different species of whales. In fact, scientists can pinpoint a particular species of whale at a given location at a specific time — even particular whales within a given species. A few years ago, one particular blue whale was tracked for 48 straight days as he traveled 1,450 miles across the Atlantic.

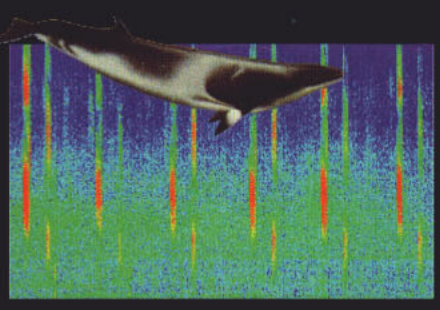
Scientists at the Naval Research Laboratory use what are called spectragrams to differentiate between different sounds in the ocean. Once IUSS has detected a particular sound, it will create a "visual representation of that sound," or a spectragram. Every object, animal or organism that makes a sound in the ocean has a different spectragram. Though this technology was designed and engineered to detect the activity of enemy submarines during the cold war, researchers have discovered that detecting whales is much easier — submarines try very hard to be quiet, while whales love to make a lot of noise.



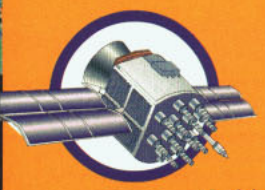
Blue Whale



Fin Whale



Minke Whale



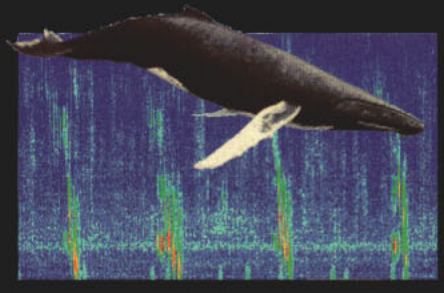
Exploring the Ocean Basins with Satellite Altimeter Data

In an age when we are mapping the surfaces of Venus and Mars, it is difficult to believe that so much of the ocean floor remains uncharted. Why? Well, the main reason is because it is covered by 2 to 3 miles of seawater! Electromagnetic waves cannot penetrate the deep ocean, therefore we cannot "take pictures" of the sea floor. Instead, common mapping practice has been to determine depth by timing the two-way travel of an acoustic pulse. But, because research vessels travel quite slowly, about 12 knots maximum, it would take approximately 125 years to chart the ocean basins using this technique! That may explain why only a small fraction of the sea floor has been charted by ships.

But, that all may be changing because of a new radar altimeter installed aboard the Seasat spacecraft launched by NASA. Recently, high density data collected by the U.S. Navy's Geosat satellite has been able to show the ocean-floor in unprecedented detail.

The Geosat altimeter orbits the earth 14.3 times per day resulting in an ocean track speed of about four miles per second. As the spacecraft orbits the earth it collects a continuous profile of height across an ocean basin. Profiles from many satellites, collected over many years, are combined to make high resolution images.

Visual representations of sound recorded beneath the ocean, called spectragrams, are studied by ocean researchers tracking whale movements all over the world. The sound noted on this spectragram was made by a humpback whale.



Humpback Whale

Haakon Mosby Mud Volcano

There may be "nothing new under the sun," but in the sunless depths of the ocean floor, there is always something waiting to be discovered — the Haakon Mosby mud volcano for example! The volcano was first imaged by a Naval Research Laboratory (NRL) sidescan sonar in 1989. It was later revealed to be a hydrate-covered, methane-spewing sediment volcano after an NRL-led, joint U.S. and Norwegian expedition in 1995.

Located in the North Atlantic, in water depths of more than 1 and a half miles, the Haakon Mosby mud volcano is an unparalleled natural laboratory in which to investigate the processes involved in the formation of methane in the marine environment.

Why's methane so important? Methane is a clean-burning fuel and a potent greenhouse gas. Methane pockets are highly explosive in our oxidizing atmosphere, as coal mine disasters remind us. However, in the deep ocean, where methane is more stable because of the decreased temperature and increased pressure, methane could someday become a major fossil fuel source. As a result of organic matter burial under the vast submerged continental margins, enough methane has been generated to form an immense carbon reservoir.

While exploring the Haakon Mosby mud volcano NRL researchers discovered several "new" species of marine life. In addition to "vermicelli-spaghetti-like" tube-worms, scientists found more than 20 new species of meiofauna (sand-grain-sized animals from various families) and a bottom-fish density more than one hundred times that found on the normal seafloor. These organisms did not have photosynthesis as the base of their food chain, but used a methane-based chemosynthesis. The fish, dominated by a species of eelpout measuring the length of a pen, congregate around the mud volcano much like seagulls do at the local dump.

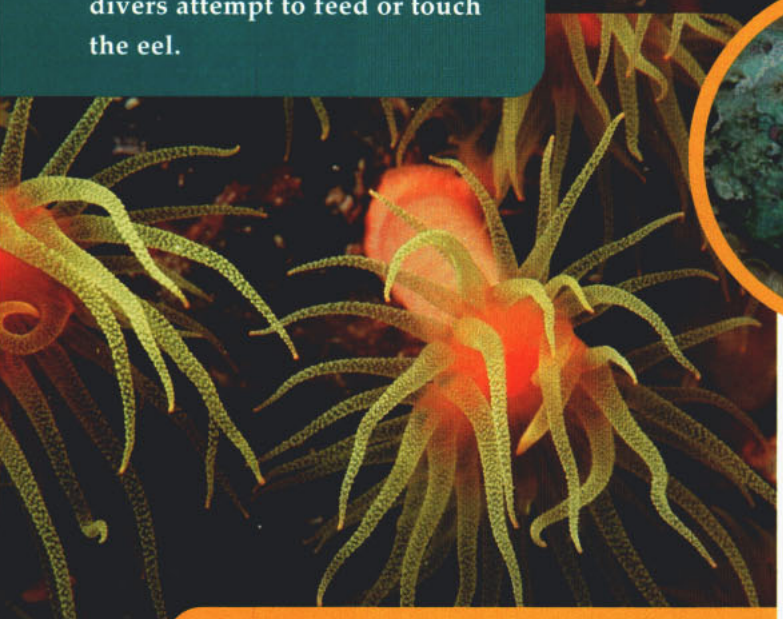
Sea c

Dragon Moray Eel

Of all the creatures dwelling near the coral reef, the dragon moray eel is one of the most ominous. Because they breathe through their mouths, they often present an apparent menacing pose which is mistaken as a threat display. Eel bites are normally caused when careless divers attempt to feed or touch the eel.

Crab

There are approximately 4,500 species of crabs around the world. This particular crab is called the 7-11 crab because of its unusual markings. Hawaiian folk lore says that the seven spots are from the blood of a Hawaiian god who was bitten by the crab.



Sleeping Parrot Fish

The sleeping parrot fish is one of about 80 species of parrot fish found on tropical reefs. These fish have bright colors, large scales and a characteristic bird-like beak. The beak is used to scrape algae from coral reefs and is strong enough to leave noticeable scars in the coral. The fish grind their food and bits of coral with plate-like teeth in their throats. Parrot fish usually grow to be about a foot long, but they can get as large as four feet and weigh up to 45 pounds. At night, they spin a mucus cocoon in which they sleep protected from predators.

Tubastria Coral

A night feeder, this coral remains in its polyp during the day. About two inches in length, it is found under ledges, inside wrecks and caves and other places out of sunlight.

Photos by CAPT Jeff LaDouce

ritters

Hawaiian Green Sea Turtle

Hawaiian green sea turtles grow slowly, taking from 10 to 50 years to reach sexual maturity. This species also ranks among the largest on Earth. Small turtles can be up to 28 inches long and weigh nearly 100 pounds - the largest can weigh as much as 400 pounds. Sea turtles swim by beating their flippers the same way a bird flaps its wings. Sea turtles cannot withdraw into their shell so they depend on their size and swimming speed for defense. They are a protected species.

Sea Squirts

The sea squirt is a jelly-like animal that closely resembles a potato. These animals live on the bottom of the ocean and have a habit of squirting out water through one of two body openings. A sea squirt receives its food from water which it draws into the digestive tract through one of its openings, and it squirts out the water from the other opening. Sea squirts are commonly found fixed to pier pilings, ships' hulls, rocks, large seashells and the backs of large crabs.

Pacific Double Sided Butterfly Fish

This fish is one of the many brilliantly colored species that live in warm, shallow waters and in areas with rich healthy corals. These fish grow to be about six inches.

Purple Flat Worm

Purple flat worms are usually found during the day crawling over limestone or volcanic rocks.

Helmet

Hunting by night, these snails are carnivores and sometimes cannibalistic. This baby snail is just starting out. Adults can reach up to a foot in length.

Sea Horse

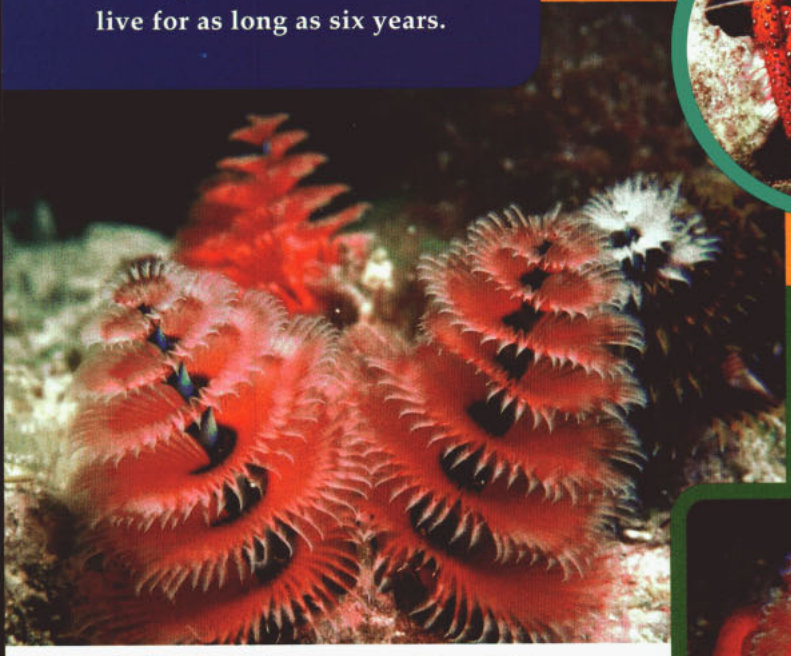
The sea horse is a small, odd-shaped fish that lives in temperate and tropical waters. It has a long snout and prominent eyes. Its body is about 5 inches long and is covered with spiny, armor-like plates that protect it. The sea horse uses its tail to cling to rooted plants or growths of floating sea vegetation. Sea horses can live for as long as six years.

Scorpion Fish or Lionfish

This carnivore lives in coral and rocky reefs and grows to be more than a foot long. Its fins may be beautiful, but they are also very deadly. The lionfish will use these sharp-as-needles, poisonous spines to attack other fish. It will also use them as a defense against divers who swim too close.

Hermit Crab

Unlike other crabs, the hermit has soft, unprotected body parts. The hermit crab relies on the misfortune of snails and other mollusks for its home, twisting its body into the spiral of an empty shell. As the crab grows, it exchanges the shell for a larger one.

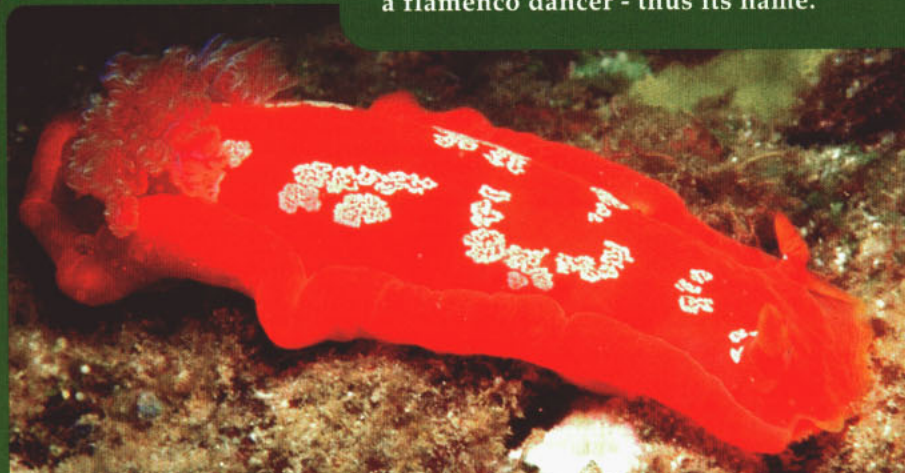


Salmon Christmas Tree Worm

These spiral worms live in tubes within the coral. While extended, the filaments filter food down the spiral shaft to the worm's mouth.

Spanish Dancer

One of the world's largest nudibranches, this species can grow to be more than a foot in length. When swimming, the white edge of its skirt resembles a flamenco dancer - thus its name.

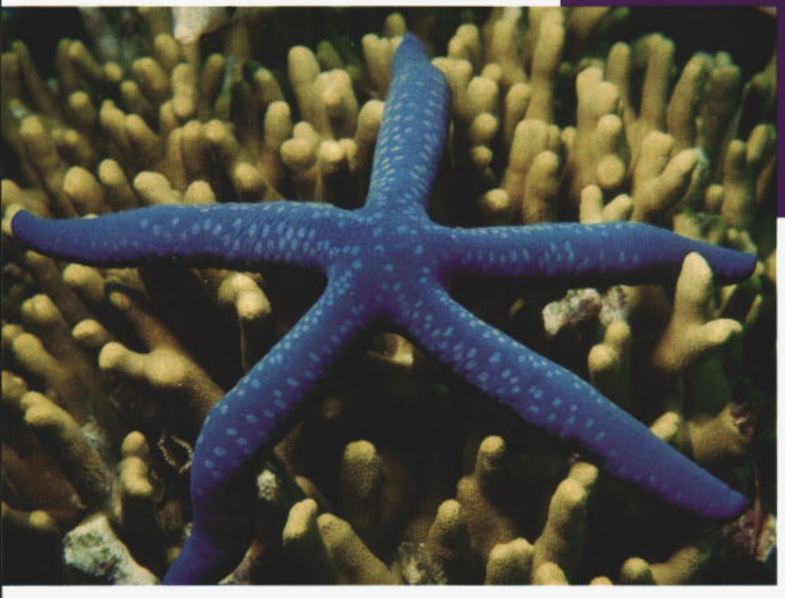


Freckled Lip Blenny

Blennies are small (two inches) fish found in shallow water. Never venturing far from its hole, it will dart, tail first, into the hole when frightened.

Blue Chromis

This colorful fish lives in schools in shallow reef areas as juveniles. When frightened, the entire school will disappear into the coral until the danger has passed. Adults can grow as large as two and a half feet.



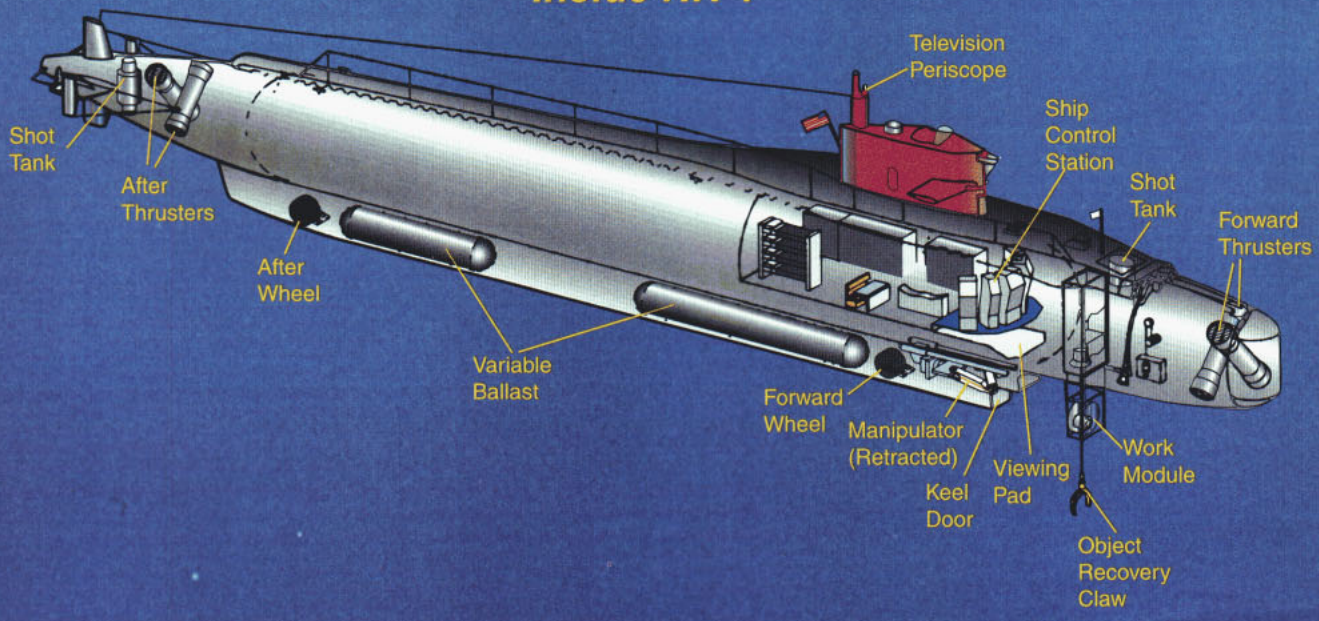
Blue Starfish

Most starfish, or sea stars, have five arms, although, some species have as many as 50. Starfish live in all of the world's oceans, but they are not fish. They are in the same family as the sea cucumber, sea lily and sea urchin. Many starfish feed on shelled animals such as mussels, clams and oysters. The animal uses the suction disk at the end of each foot for crawling and sees with a small colored eyespot located at the tip of each arm. Most starfish live for three to five years.

Hawaiian Night Octopus

The Hawaiian night octopus is a member of the octopus family, which is a large group of widely distributed, shallow-water mollusks. Octopods vary in size from 2 inches to 18 feet and may have an armspan of more than 30 feet. They crawl on the bottom of the ocean, or when alarmed, shoot swiftly backward by means of a jet of water. When threatened, they eject an inky substance, which is used as a screen. Octopods feed mainly upon crabs and lobsters, although some are plankton feeders. The body and legs of a Hawaiian night octopus are much slimmer than its relatives.

Inside NR-1


Television Periscope
Ship Control Station
Shot Tank
Forward Thrusters
Shot Tank
After Thrusters
After Wheel
Variable Ballast
Forward Wheel
Manipulator (Retracted)
Keel Door
Viewing Pad
Work Module
Object Recovery Claw

3,000 feet down

A small nuclear submarine and its crew journey to the bottom of the sea in search of answers

Story by JO2 Jeremy Allen

Most Sailors probably have never seen or heard of NR 1. But, the Navy's smallest nuclear-powered submarine has been operating since 1969.

NR 1 is 146-feet long, 12-feet wide and displaces 365 tons. Its mission is to search the ocean floor in support of geographical and oceanographic research and install and maintain underwater equipment. The sub and its support ship, SSV *Carolyn Chouest* are both homeported in New London, Conn.

During their most-recent deployment, NR 1's 11-person crew provided vital support to Dr. Robert Ballard of Wood's Hole Oceanographic Institute and the National Geographic Society in excavating three Roman-era shipwrecks in the Straits of Sicily. They also conducted a two-week search for the still-missing Israeli naval submarine, INS *Dakar*.

NR 1 is a unique nuclear submarine. With a top speed of 4 knots, NR 1 can't cover great distances quickly. In fact, its support ship, *Carolyn Chouest*, tows the submarine to each research site. The submarine can then submerge to depths of 3,000 feet and use its highly-sensitive sonar system to detect and identify objects as far as a mile away.

The submarine is equipped with a hydraulically powered manipulator arm which can be used to lift up to 1,000-pound objects from the ocean floor. NR 1 also has two retractable rubber-tired bottoming wheels that allow it to drive along the ocean floor.

NR 1 is powered by a nuclear-powered, steam-driven turbo-generator with electric-drive. "The [sub] has an unlimited life span and can operate until 2013 before it needs to be refueled," said RADM Joseph Krol, director, Deep Submergence Branch.

NR 1's ability to research the ocean floor is possible because of its ability to see and record the deep sea environment. The sub was designed with three 4-inch viewports positioned on its bottom, 19 250-watt gas discharge lights, eight 1000-watt and two 500-watt incandescent lights and 16 low-light TV cameras.

Allen is a staff writer assigned to All Hands.

JASON'S Argonauts

For nine years the Jason Project has given children the opportunity to journey to some amazing places without even leaving home.

Students in classrooms around the world are talking about it. Maybe you've even seen it on a trip to the aquarium. Or maybe it's still a mystery to you. And what is this wonder of the world, you ask? KELP is the buzzword around town these days, and it's coming to a computer screen near you via "kelp cam," a live view of Monterey Bay Aquarium's kelp forest exhibit. This virtual field trip to the bottom of the sea is just one aspect of *Jason Project IX*, Oceans of Earth and Beyond.

The *Jason Project* is celebrating the International Year of the Ocean with an entertaining and educational excursion to the waters of Monterey Bay, Calif.; Bermuda; and the Guaymas Basin, where scientists, students and teachers will explore ocean environments and the life they maintain (including, of course, kelp).

In its ninth year of existence, *Jason Project* was founded by Dr. Robert Ballard after he discovered the wreckage of the RMS *Titanic* in the North Atlantic. Thousands of children sent him letters expressing their desire to join him on his next adventure, and Ballard obliged by creating *Jason*, an interactive, long-distance and hands-on learning program designed to get students excited about the sciences. So far, the project has been incredibly successful.

Dr. Robert Ballard founded the *Jason Project* to give students all over the world a chance to join him on his undersea explorations.

This year's project featured innovations utilized in past projects as well as several new technological feats. Students located at PINS (Primary Interactive Network Sites) around the globe watched live, via satellite and the internet, as Ballard and his team of scientists and student and teacher "Argonauts" probed the mysteries of the deep at Monterey Bay. Conducting experiments and maintaining a lookout for organisms rarely observed, Ballard and his Argonauts broadcast each facet of the expedition during a two-week period in March from the Monterey Bay Aquarium.

The Argonauts worked from the ship *McArthur*, a member of the fleet of the National Oceanic and Atmospheric Administration (NOAA).

During *Jason Project VII*, Ballard and his team were given the opportunity to travel with U.S. Navy nuclear-powered research submarine NR-1 as it mapped previously-unexplored areas of Florida Coastal waters. "What I enjoyed most was the honor of going down in the NR-1 submarine. At the 300-foot depth, the ocean bottom is like the surface of the moon," raved one *Jason VII*

A teacher Argonaut prepares for a live broadcast during *Jason Project VII* in the Florida Keys. During this two week expedition, Dr. Robert Ballard and his team of scientists, students and teachers made 20 live broadcasts to students located at Primary Interactive Network Sites (PINS) around the country and around the world. Twenty-seven PINS are located throughout the United States, with one each in the United Kingdom, Mexico and Bermuda.

student Argonaut.

During the summer of 1997 in an independent project, Ballard used the NR-1 again in the Mediterranean Sea to find Roman shipwrecks dating back to the fourth century A.D.

Members of the *Jason IX* expedition searched for treasures of a different kind. Studying shallow, mid-water and deep ocean environments, the Argonauts took a mystical journey to Monterey Bay, where they studied coral reefs, hydrothermal vents, cold seeps, marine snow, exotic deep sea creatures and the ever-popular kelp forests.

Fifteen-year-old Jeffrey Steynor, a *Jason IX* Argonaut from Bermuda, said that *Jason* gave him "the experience of a lifetime" and has spurred him to pursue a career in the sciences.

Throughout the live broadcasts, students at the PINS and on the internet, who prepared all year for the expedition using a specialized curriculum developed by the Jason Foundation for Education, were able to take part in the project on a highly-interactive level.

Not only were they be able to discuss the project with Ballard's team, but they also had the opportunity to operate live-feed video cameras and control remote-operated vehicles on the ocean floor. This "you-are-there" technology, called "telepresence," represents a revolution in distance learning.

For the first time, the *Jason Project* featured ocean-to-ocean communication, which linked the Monterey Bay project site with its sister site in Bermuda. Scientists working from the two locations were able to examine simultaneously the Pacific and Atlantic waters to compare their findings and to communicate with students viewing the broadcasts.

Some of the experiments students conducted onsite included researching the effects on water quality of sedimentation caused by El Niño, finding differences between kelp collected from the aquarium and kelp found in Monterey Bay and comparing "domestic" sea urchins to those who thrive in the Bay.

Jason IX also brought new meaning to the phrase "surfing the web." The internet played a major role in this year's project. In addition to the famed "kelp cam," interest in the sciences and technology has been burgeoned by Jason's website, *www.jasonproject.org*. Ballard applauds the site as a critical learning tool that has brought information on the project to more individuals than previously thought possible.

Students working with the *Jason* curriculum have fully experienced the interdisciplinary nature of the project. They started out their adventure by reading Jules Verne's 20,000 Leagues Under the Sea . They then were encouraged to discuss the novel online with other students involved in the project.

Students also followed the ongoing work of NASA researchers with the NASA Stardust mission in preparation for the expedition in March.

Next year *Jason* will travel to the rain forests of Peru for its th anniversary expedition, where Ballard and his Argonauts will once again brave the wilds in order to render science and technology exciting for students all over the world.

JASON PROJECT™

Winning the war against the elements

U.S. Navy photo

Oceanographic ships help others avoid the storms

Story by Steve Rosa

A guided-missile cruiser is steaming home across the Atlantic. At 1 p.m., off Cape Hatteras, it encounters winds of 21 knots and seas of eight feet. Three hours later the winds have almost doubled. By midnight the seas are 21 feet high and the cruiser is rolling hard. The ship is up against the North Wall of the Atlantic Gulf Stream where the combination of warm gulf water and cold air can rapidly generate dangerous wind and wave conditions.

Meanwhile, a submarine prowls the depths just below, playing a dangerous game of hide and seek. To complete its mission, the sub needs to know temperature distribution, current strength, bathymetric data and much more. The world under the waves is still a hazardous combination of volcanic cones, great, featureless plains, chasms bigger than the Grand Canyon and mountains that dwarf even Mount Everest. To operate undetected in such an environment can be treacherous if you don't have a detailed road map.

> *"They are stellar, state-of-the-art performers ..."*
>
> *— CAPT Craig Upton, MS22C civilian mariner and former USNS Pathfinder master*

Fortunately, Navy oceanographers and the Military Sealift Command can help. Whether it's keeping Navy ships away from heavy seas or providing charts of the undersea world, the Navy's oceanography community and its fleet of eight oceanographic ships, operated by Military Sealift Command, criss-cross the world's oceans collecting huge amounts of topographical data.

Photo by Gail S. Cleere

USNS *Pathfinder* First Mate Charles Rodriguez demonstrates how to lower the conductivity, temperature and depth (CTD) probe for *Project Marco Polo* students.

Despite their size (about 300 feet in length), oceanographic ships play a vital role in national defense — by allowing the Navy to go about its business. These ships take the ocean's pulse. They help to maintain an ever-growing database of nautical information used by mariners all across the globe. More than anything, they provide ship captains with the information they need to make an accurate assessment of oceanographic conditions.

To keep navigational science and safety progressing, a new class of ships, the T-AGS 60 class, is taking the oceanographic world by storm.

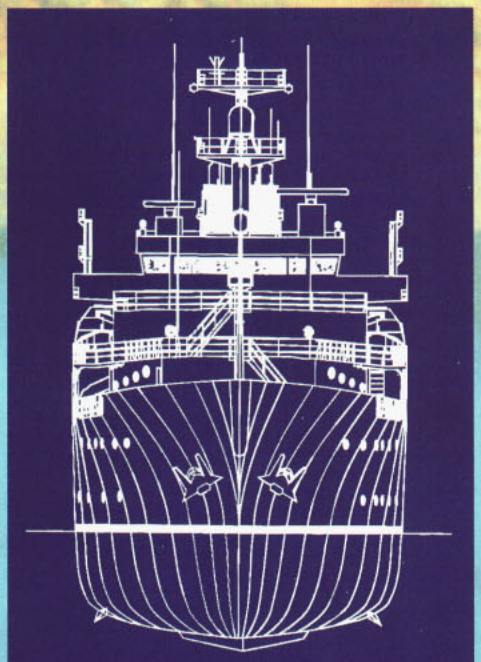
"They are stellar, state-of-the-art performers," said CAPT Craig Upton, an MSC civilian mariner and former USNS *Pathfinder* master. "With their ultra-modern propulsion systems and high-tech survey equipment, the result is something to be proud of."

The result is a class of five ships, with four operating and one under construction. MSC civilian mariners operate the ships and assist Navy oceanographers with oceanographic surveys. Twin z-drive motors give the ship remarkable handling. Combined with a global positioning system on board, these ships have a much-improved station-keeping ability.

T-AGS 60 ships are chock full of specialized oceanographic equipment: ocean floor, current, temperature and velocity profilers; a seismic system, to measure underwater seismic activity; a magnetometer, for mapping the earth's magnetic field; a sonar system capable of charting waters from 10 to 11,000 meters in depth; and a surface weather monitoring system. All the electronics add up to one very impressive ship; one that is capable of gathering mountains of data on various ocean phenomena in a very short time.

Oceanography is an on-going study because the oceans are alive. Humans change things; nature changes things. Oceanographic ships are deployed to ensure those changes are on record — by watching the ocean and waiting for her to reveal her secrets.

Rosa is a public affairs specialist with Military Sealift Command, Washington, D.C.



Length, Overall	329 ft
Beam	58 ft
Draft at Full Load	19 ft
Displacement at Full Load	5,000 LT
Lightship Displacement	3,019 LT
Speed, Sustained	16 Kts
Station Keeping	300 foot radius with 2 Kts current, 27 Kts wind
Endurance	12,000 NM @ 12 Kts plus 29 days @ 3 Kts with 10% Fuel Reserve
Power Plant Diesel-Electric System	8,520 KW @ 600 VAC
Propulsion Motors	(2) Main Z-Drives 8,000 HP
Bow Thruster	Retractable @ 1,500 HP
Ice Strengthening	ABS Class C
Certification	USCG Certified/ABS Classed
Total Accommodations	55
Officers and Crew	25
Scientists	27
Spares	3

Ocean Fact

The United States has more than 95,000 miles of coastline and more than 3.4 million square miles of ocean within its exclusive economic zone.

OCEAN VOYAGERS

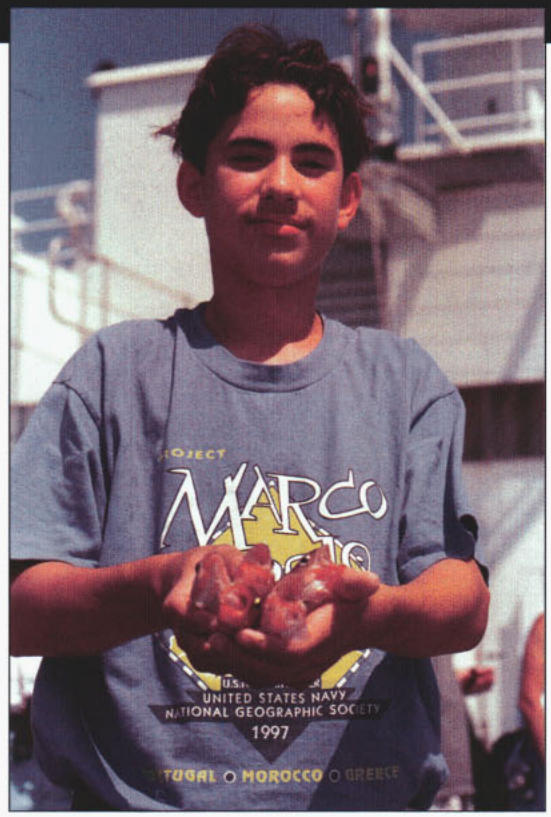
Project Marco Polo *continues to expand the horizons of young people all across the country.*

Story and photos by Gail Cleere

Marco Polo was one of the greatest explorers this world has ever seen. His thirst for knowledge pushed him to the farthest reaches of his known universe. But, it was his respect for the cultures he encountered that earned him a lasting legacy.

By the turn of the 14th century, Marco Polo was famous. His book, *Description of the World*, based on his travels to central Asia and China, was the most widely read book in Europe. It influenced many of the early explorers, including Christopher Columbus.

Today, Marco Polo's name and legacy are still influencing explorers around the world. For the past eight years, the Navy and the National Geographic Society have co-sponsored a program that takes students and teachers overseas on the Navy's



Steve Fragoza, a student from San Antonio, Texas, never saw anything like the creatures found in the bottom trawler.

While sailing from Tangier, Morocco, to Syros, Greece, USNS *Pathfinder* Master Curt Smith demonstrates how to use a sextant to Ben Korin, a student from Bethel, Conn.

oceanographic survey ships. *Project Marco Polo* emphasizes oceanography, as well as the need for a greater understanding of the customs and traditions of foreign cultures.

Going where few students and teachers have gone before, *Project Marco Polo* participants have journeyed to locations as diverse as Indonesia, Egypt and North Africa.

This past summer, *Project Marco Polo* was conducted aboard USNS *Pathfinder*. Traveling from Lisbon, Portugal, to Syros, Greece, students and teachers from Texas, Oklahoma, Mississippi and Connecticut studied geography, history, language and the arts as they immersed themselves in the customs and traditions of foreign cultures. While at sea, they dropped bottom cores, studied oceanography and meteorology, practiced the art of navigation and even performed biological studies on marine life. The experience prompted Bill DeGrazia, a teacher from Connecticut, to write in his journal, *"Salinity tests on the aft deck this morning — it doesn't get any better than this."*

"Salinity tests on the aft deck this morning — it doesn't get any better than this."

- Bill DeGrazia
Teacher

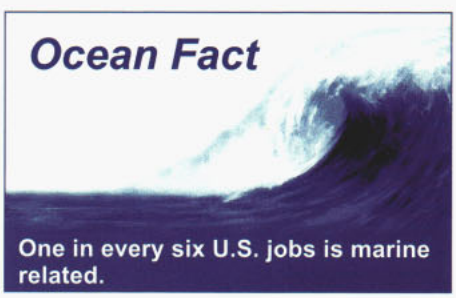
Erika Curtis, a student from New Braufels, Texas, eyeballs the red starfish she found among the other sea creatures pulled up in the bottom trawl conducted aboard USNS *Pathfinder*.

Project Marco Polo will tack in a new direction this year. With a grant from the Navy, St. Norbert College, DePere, Wis., will assume management of the program via the *Ocean Voyagers* program and add a few new twists. The teachers selected for the program will now take a more active role in developing the curriculum. As opposed to past years, when participants were merely exposed to oceanographic operations, teachers will now be more focused on bringing oceanography and world studies into the classroom, with a hands-on curriculum. These curricula will be available on the *Ocean Voyagers* website (*http://voyager.snc.edu*).

This summer, in honor of *Year of the Ocean*, six winners of the National Ocean Science Bowl (one teacher and five high school students), and a teacher and a student selected through the Mississippi Science and Engineering Fair will participate in *Project Marco Polo*. They will board the Navy's oceanographic survey ship USNS *Pathfinder* and perform a variety of oceanographic surveys en route to Lisbon, Portugal where they will attend *Expo '98*. At one point in the survey, the *Project Marco Polo* participants will join the six middle school teachers embarked with the *Ocean Voyager* program.

Marco Polo's legacy of learning is alive and well in the hearts and minds of these brave explorers who sail in his name. These *Ocean Voyagers* will surely chart new educational seas!

Cleere is the public affairs officer for Oceanographer of the Navy.



HOW WEATHER & WATER AFFECT LITTORAL OPERATIONS

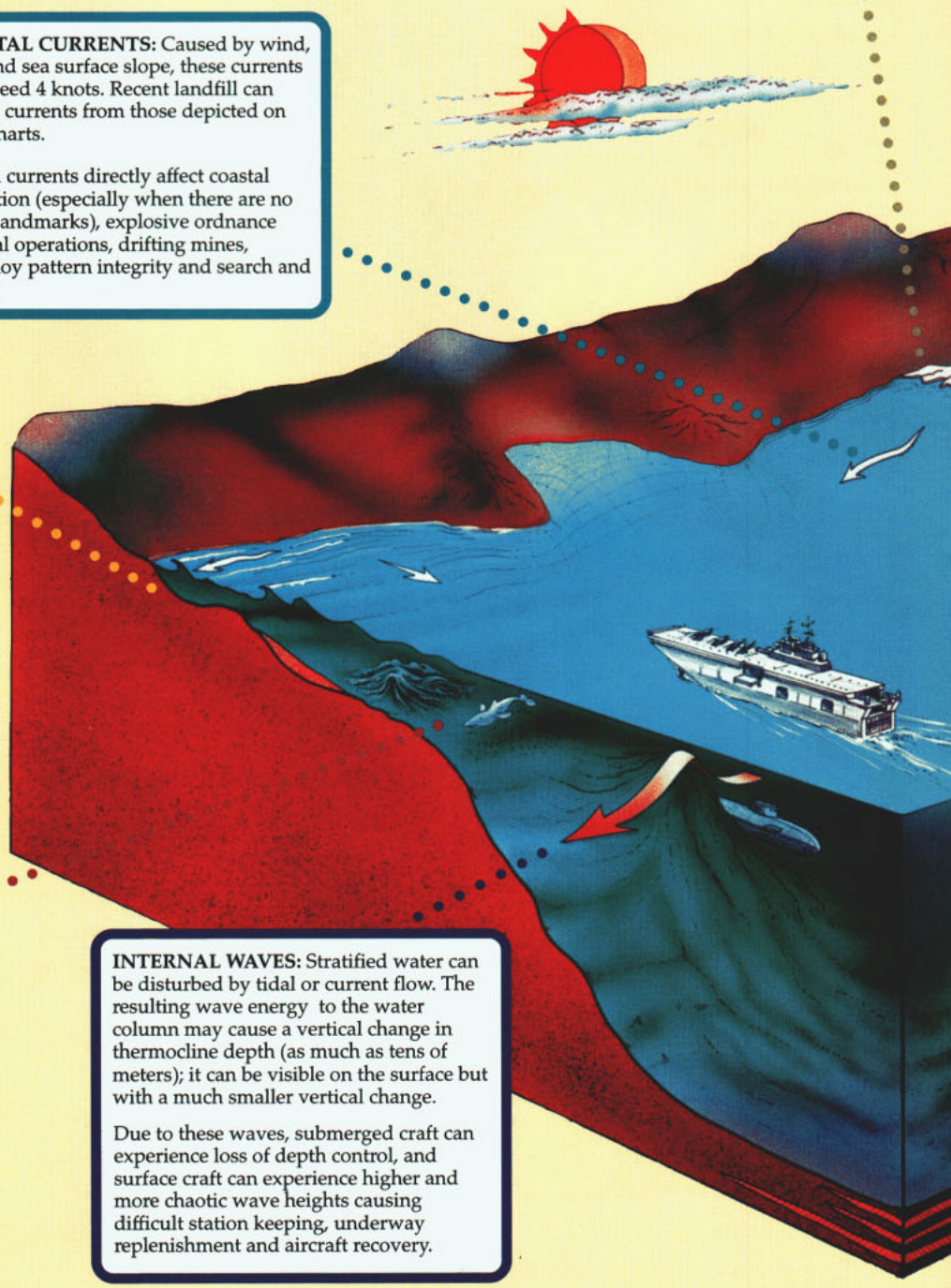
The littoral zone is that area extending from coastal waters inland along the shore. Although deep water operations remain important, it is critical that Sailors and Marines learn how to operate in this rather unique environment. In the littoral, there are a number of weather and oceanographic factors which can affect our ability to fight. Here, we present only a few of the more prominent.

LAND-FAST ICE: Consolidated sea ice attached to the coast can typically extend offshore to 2 to 25 meter depth with extreme extents (100 to 200 km) observed in vicinity of offshore islands. It will cover constricted channels and bays regardless of depth and ridges of 1 to 3 meters may occur with maximum thickness of 2 to 3 meters. Ice will modify the salinity of water.

Ice can become an extreme navigational hazard. Coastal ports are often inaccessible without icebreaker support. Ice may also be a formidable obstacle to amphibious craft, swimmers and torpedo. It impairs submarine operations due to decreased depths.

COASTAL CURRENTS: Caused by wind, tides and sea surface slope, these currents can exceed 4 knots. Recent landfill can modify currents from those depicted on older charts.

Coastal currents directly affect coastal navigation (especially when there are no visual landmarks), explosive ordnance disposal operations, drifting mines, sonobuoy pattern integrity and search and rescue.



BEACH PROFILE: Sand profiles change seasonally and often after storm passage; barred beaches with rip currents are common.

Equipment-laden troops can drown in deep trough inshore of bar; wave activity adversely affect amphibious craft.

LITTORAL MARINE LIFE: Dangerous marine life (e.g., jellyfish, scorpion fish, saltwater crocodiles) may be present, and typically there is more marine life present than in near-surface open ocean.

These creatures can present a possible hazard to reconnaissance personnel. Kelp beds can impede special warfare and amphibious operations.

INTERNAL WAVES: Stratified water can be disturbed by tidal or current flow. The resulting wave energy to the water column may cause a vertical change in thermocline depth (as much as tens of meters); it can be visible on the surface but with a much smaller vertical change.

Due to these waves, submerged craft can experience loss of depth control, and surface craft can experience higher and more chaotic wave heights causing difficult station keeping, underway replenishment and aircraft recovery.

TERRAIN-FORCED THUNDERSTORMS: Generally occur in the afternoon; these storms cause wind shear, heavy rain, hail and high winds.

They represent a danger to airborne operations and can degrade communications and mobility.

ONSHORE WIND: Afternoon occurrence; 8 to 14 knots; extends 5 to 10 nautical miles; can cause higher sea states; coastal hills can lift moist sea air generating clouds.

With these winds, periscope and mine detection become difficult; there are increased breaker heights in the surf zone, and inland targets may be obscured.

Ocean Fact

How much power exists in a wave? Kinetic energy of motion, in waves is tremendous. An average 4-foot, 10-second wave striking a coast puts out more than 35,000 horsepower per mile of coast.

OFFSHORE WIND: Nighttime occurrence; 4 to 6 knots; extends 2 to 4 nautical miles offshore; can carry land smoke, fog and dust offshore, reducing atmospheric visibility.

This reduced visibility can hamper coastal surface operations and cause potential dust related aircraft engine problems at sea.

TERRAIN-FORCED WIND: Terrain can force a wind direction change that may cause low-level turbulence from wind shear between wind above terrain and wind between terrain.

Therefore, air drops, parachute/glider/helicopter operations and low-level tactical air operations become more difficult and dangerous.

RIVER DISCHARGE: Fresh, often colder and less dense water enters salty, often warmer, denser water as a surface or subsurface plume, eddy or lens. Bottom sediment changes drastically due to sediment load and sediment and current flows increase.

Submarines and swimmer-delivery vehicles may require significant buoyancy compensation to prevent grounding/surface broaching. Increased current flow can affect amphibious craft and swimmer navigation.

REEFS, BARS & CHANNELS: Reefs predominate in tropical areas and are often unsurveyed. Bars and channels may change seasonally or even more rapidly; there is often rapid current flow in channels.

All three can affect approaches taken by amphibious craft, swimmers and torpedoes and can adversely affect active sonar.

BIOLUMINESCENCE: Light is produced when plankton organisms are disturbed with no correlation to weather or sea state. It can be observed from these surface to 35 feet.

The result is enhanced nighttime visual detectability of bow waves and wakes of swimmers, periscopes and surfaced and submerged craft. A ship's wake may be visible for 6 nautical miles.

SHIPWRECKS: More shipwrecks occur near shore.

These hulks can present a hazard to navigation, but a bottomed sub can merge her signature with a shipwreck to escape detection.

Art & Text by CAPT Dennis Whitford

Pathfinder of the Seas

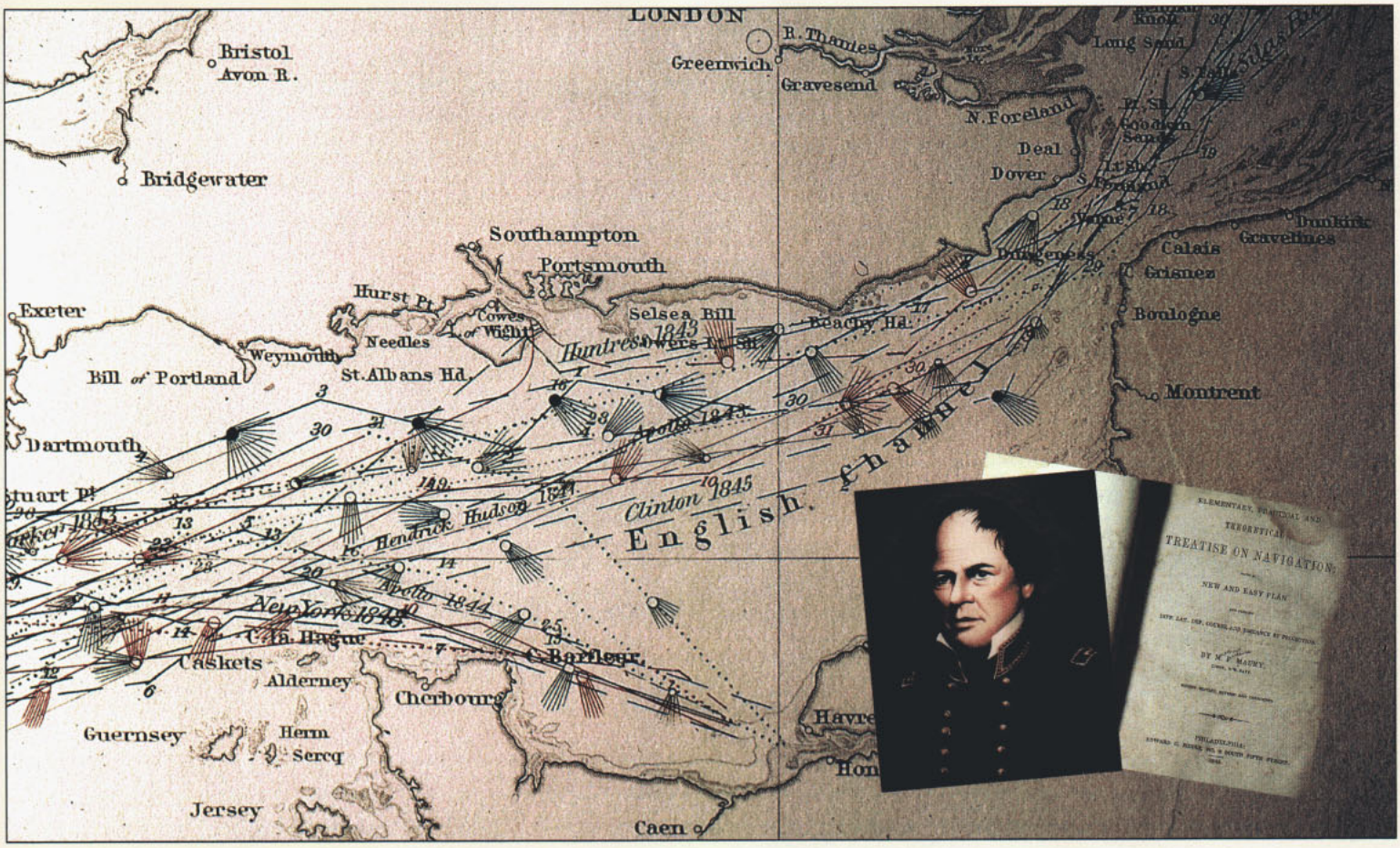
Matthew Fontaine Maury is credited with the founding of an entirely new science, the "physical geography of the sea," known today as oceanography.

Story by LCDR John Kirby

In the autumn of 1852, four commercial clipper ships began a race from New York to San Francisco. The goal wasn't to see who got there first, but to see who got there the fastest. So they staggered their departures, putting to sea at various intervals between October 12 and November 14. Such races were common then; clipper ship captains couldn't resist the temptation to compete, and the 15,000-mile New York to San Francisco run was one of the most heavily plied by the commercial maritime industry. But this contest was special. The race course had been charted by an up-and-coming, young naval officer by the name of Matthew Fontaine Maury and the results would only prove to strengthen his already solid reputation in the field of ocean science.

LT Maury, then serving as Superintendent of the Navy's Depot of Charts and Instruments, was already a recognized expert in the field of navigation. He had ecently written a textbook which was eventually **adopted by the** U.S. Navy and had already published *Wind and Current Charts* five years earlier in 1847. That book, which was based on studies he performed at sea and from information extracted from log books kept by merchant skippers, as well as his next book, *Sailing Directions*, proved highly valuable in reducing sailing times around the world. Indeed, ships had been using them to such success that the New York to San Francisco route was cut from an average of 187 days to only 144. The four clipper ship captains carried these books aboard their vessels as they raced to San Francisco.

Throughout November and much of December, the clipper *Wild Pigeon* held a commanding lead, despite having to divert off course due to poor winds. But on December 30, lookouts sighted another ship astern. Unbelievably, it was *Flying Fish*, which had set sail three weeks after *Wild Pigeon*! The two were now locked in a nip and tuck race to the finish, with *John Gilpin* a close third. *Flying Fish* eventually won, arriving in



Maury's charts revolutionized travel on the world's oceans and earned him the title "Pathfinder of the Seas."

San Francisco on the last day of January 1853, having completed the journey in an astounding 92 days and 4 hours.

Maury had, at the age of 46, revolutionized merchant traffic on the high seas. As one merchant skipper wrote to him, "until I took up your work, I had been traversing the ocean blindfolded."

1853 would turn out to be a big year for Matthew Fontaine Maury. By summer, he had become internationally famous for his chart work and dubbed the "Pathfinder of the Seas." Even so, he recognized there were vast areas of the world for which he had insufficient data and knew that he would need to enlist the help of every nation on Earth in order to gather the information he and the world needed. Thus, he began to push for the creation of a world meteorological organization. His vision was soon realized and although he was invited to preside over the inaugural international maritime conference held in Brussels, Belgium, in August 1853, he declined. He did, however, make the opening address to the conference which adjourned September 8, after having adopted internationally standardized forms and instructions for the collection of meteorological observations. This alone made the conference a huge success. However, it was the spirit of cooperation exhibited by the participating nations that struck Maury deeply. As he would write later: "Rarely has there been such a spectacle presented to the scientific world. ... Though they may be enemies in all else, here they are friends. Every ship that navigates the high seas with these charts and blank abstract [is] a temple of science." For his efforts at the conference, Maury was credited with founding an entirely new science, the "physical geography of the sea," known today as oceanography.

Later that year, Maury began

Ocean Fact

The first successful transit under ice at the North Pole was made by USS *Nautilus* in 1957. Today, Navy oceanographers regularly map the ice edge to ensure safe passage for ships and submarines.

work to locate the best route for an underwater transatlantic cable. Using a deep-sea sounding apparatus designed at the Naval Observatory (of which he had also been made superintendent), Maury began to collect specimens from the ocean bottom. From his study of these specimens, he discovered the existence of a relatively shallow underwater plateau across the Atlantic from Newfoundland to Ireland. In a letter to then-Secretary of the Navy James C. Dobbin, he described it as having precisely the correct attributes to hold the wires of a transatlantic cable. "It is neither too deep nor to shallow, yet it is so deep that the wires being once landed will remain forever beyond the reach of vessels' anchors, icebergs and drifts of any kind, and so shallow that the wires may be readily lodged upon the bottom."

In 1858, after serious consultation with Maury, American industrialist Cyrus Field and the British-based Atlantic Telegraph Company laid the first transatlantic cable along this plateau, establishing for the first time in history instantaneous communication between the Old World and the New. The first official message sent over the cable was from Queen Victoria to President James Buchanan. In his reply, the President called the cable, "a triumph more glorious ... than was ever won by conqueror on the field of battle." For his part in locating the cable's bed, Maury was praised as the "indefatigable investigator of the ocean depths."

Maury's discovery of a relatively shallow plateau across the Atlantic allowed the first transatlantic cable to be laid in 1858. Here HMS Agamemnon receives the cable onboard while at anchor.

With the establishment of the transatlantic cable, Maury had once again made history. However, the Sailor scientist's crowning achievement was probably his first commercially printed book, *The Physical Geography of the Sea*. Published in 1855, the book contained a wealth of new discoveries presented in a simple, easy to understand style. For example, Maury used information gathered from whaling vessels to theorize about the existence of a Northern passage from the Atlantic to the Pacific. Because whalers sometimes marked their harpoons with both the date and the name of their ship, when whales captured near the Bering Strait had harpoons in them from ships known to cruise the waters of the North Atlantic, Maury concluded that the dates were too recent for them to have gone from Atlantic to Pacific by way of Cape Horn or Good Hope. "In this way," wrote Maury, "we were furnished with circumstantial evidence that there is ... open water communication through the Arctic Sea from one side of the continent to the other, for it is known that the whales can not travel under the ice for such a great distance."

> ***"Navies are not all for war. Peace has its conquests, science its glories. And no Navy can boast of brighter chaplets than those which have been gathered in the fields of geographical exploration and physical research."***
> ***— Matthew Fontaine Maury***

In addition to his many remarkable discoveries, the book also included detailed charts and diagrams explaining everything

from wind and currents to temperature and tides.

The Physical Geography of the Sea received swift praise and became a huge bestseller. In its first year of publication alone, the book went through five printings. Maury was becoming famous both at home and abroad as the book was subsequently printed in France, Holland, Germany and Italy. Great Britain's Royal Astronomical Society called it, "one of the most fascinating books in the English language." The book was revolutionary. It was the first book ever to embrace the entire sea as its theme, and it did so in a way which everyone could appreciate. It brought the world of oceanography to the common man. Perhaps more importantly, the scientific principles which Maury set forth remained relevant for many years afterward, making his book the model for all writers of popular science.

Later in 1855, a naval board that had been convened to review the officer list inexplicably placed Maury on a leave of absence. At the height of his fame, Matthew Fontaine Maury was out of a job. Through persuasive arguments and the help of Senator Sam Houston of Tennessee, Maury was reinstated in 1858 at the rank of full commander. He continued on in his duties at the Naval Observatory until 1861, when war broke out between the states. Feeling greater allegiance to his home state of Virginia than to the Union, Maury resigned his commission and volunteered for service in the Confederate Navy. He served for a time as the coordinator of Southern coast, harbor and river defenses before being shipped off to Great Britain for duty as a Confederate emissary. In that capacity he was able to procure a number of warships for the fledgling rebel navy, including the *Georgia*, which sailed from Scotland in April 1863 and captured several Union prizes. After the war, Maury worked in Mexico as the immigration commissioner, wrote several more scientific books and eventually settled down to life as a professor of meteorology at Virginia Military Institute. He died Feb. 1, 1873.

Matthew Fontaine Maury was one of the greatest scientific minds of his time and one of our Navy's most influential pioneers. Because of him naval personnel began to fully understand the medium in which they work — the sea. That we have come so far in our knowledge of the oceans, and that we have grown to be such good stewards of the environment is directly creditable to this talented "Pathfinder."

Kirby is the head of still media, Naval Media Center, Washington, D.C.

THE MAURY PROJECT

The Maury Project, named for Matthew Fontaine Maury, is the American Meteorological Society's comprehensive national program of teacher enhancement based on studies of the physical foundations of oceanography. It is conducted in partnership with the United States Naval Academy and the National Oceanic Atmospheric Administration. It is directed toward improving teacher effectiveness in generating interest and understanding in science, technology and mathematics among pre-college students at all grade levels and across the curriculum.

A major component of the Maury Project is the offering of training and information sessions to teachers around the country on oceanographic topic and issues. The sessions are conducted by Maury Project Peer Trainers who have attended an extensive summer training program at the Naval Academy. Teachers at all pre-college grade levels seeking greater understanding of oceanography are encouraged to attend. For more information about the Maury Project contact the U.S. Naval Academy public affairs office at (410) 293-2291 or visit the Project's website at: / / atm.geo.nsf.gov / AMS / amsedu / maury.html

To learn more about the life of Matthew Fontaine Maury, visit his website at: http:// www.cstone.net/ ~wmm/MAURY/ index.html

Environmental Innovations

Environmental Aces

Naval Aviation Depot (NADEP) Jacksonville and the Jacksonville Offshore Fishing Club (JOSFC) recently added several stripped-out, Vietnam-era aircraft to an existing artificial reef off the Jacksonville coast.

Eight A-7 jets and a T-2 trainer aircraft were sunk about seven miles off the coast of Jacksonville Beach, Fla., in 70 feet of water.

For years environmentalists have been concerned about the decline of nursery habitats for several species of fish and shellfish in the Jacksonville area. This decline can be traced to increased coastal development and the ever-growing popularity of sport fishing in Florida-Georgia waters.

These much needed artificial reefs provide food, shelter, protection and spawning areas for hundreds of species of fish and other marine organisms.

This is the second time in two years the Navy has contributed military hardware to build an artificial reef in North Florida waters. In August 1995, 33 A-6 aircraft were sunk about 22 miles east of St. Augustine, at a depth of almost 100 feet. Those aircraft, which had been earmarked to be overhauled at the Grumman plant in St. Augustine, had been relegated to the scrap heap after maintenance inspectors judged the aircraft to be uneconomical to repair.

Pulp Non-Fiction

When it comes to safely and properly disposing of trash at sea, the Navy doesn't mess around. With the help of a new machine called a pulper, invented by the Navy engineers and civilian contractors at Naval Surface Warfare Center, Carderock Division and GEO-CENTERS, Inc., at-sea waste disposal just moved into the 21st century.

Pulpers are designed to process the biodegradable solid waste generated by Navy surface ships. This includes paper, cardboard and food waste. They work in much the same way as your household garbage disposal, just on a much bigger scale — much bigger. Navy surface ships generate pulpable solid waste at a rate of about 2.3 pounds per person per day. That's almost 700 pounds a day on a 300-Sailor destroyer or more than 15,000 pounds per day on a 6,500-Sailor aircraft carrier!

Plastic, glass or anything else that could threaten marine life, harm the environment or create a hazard for navigation is separated from the biodegradable waste and stored for in-port disposal.

The Navy plans to equip the entire fleet with these impressive garbage grinders by the end of the year 2000.

How does it work?

Pulpable waste is fed into a seawater-filled pulping tank, where a two-bladed cutter chops up the waste until it's a slurry that fits through quarter-inch screen. The pulp is then fed into a seawater-powered eductor, where it is discharged overboard.

Because metal, glass and plastics sometimes end up in the waste feed, the pulper is designed to separate these materials without damaging the pulper. Metal and glass end up in a collection bin called the junk trap, and plastic stays in the tank until the machine is shut down and cleaned.

Protecting Our Resources

Defending the freedom of the seas and maintaining national security are just two of the Navy's many missions - protecting the oceans and their natural resources is another. The Navy has one of the most comprehensive and advanced environmental programs in the world.

The environmental impact of training exercises has been significantly reduced in recent years by moving bombing, gunnery practice and high-speed operations away from critical habitats.

The Navy is also very involved in the protection of several endangered species, including the northern right and humpback whales and several species of sea turtles. Extra lookouts are also posted when transiting habitat areas.

Ocean Fact

One third of the nation's gross domestic product is produced in coastal areas through fishing, transportation, recreation and other industries dependent on healthy waters and marine habitats.

Ocean IQ

Ahoy mates! Here's a quiz to test your oceanographic minds. After you select your answers, turn to Page 48 and see if you're correct. Good luck and full speed ahead!

1. *El Niño is the name given to —*

(a) The tallest mountain in Chile.
(b) A Mexican rock band.
(c) A particular kind of Mediterranean storm system.
(d) Unusually warm surface waters in the eastern Pacific.

2. *A "bathythermograph" is —*

(a) A device for measuring wind speed and direction.
(b) Something useful for determining sound speed in the ocean.
(c) A map of sea surface water temperatures.
(d) A kind of thermostat used in the bathtub.

3. *A "tsunami" is —*

(a) A kind of Japanese sushi platter.
(b) A monsoon.
(c) What used to be called "a tidal wave."
(d) An outrigger canoe used in Polynesia.

4. *Which of these organisms is used to replace human bone?*

(a) Tubeworms.
(b) Zooplankton.
(c) Turtle shells.
(d) Coral.

5. *"The Pathfinder of the Seas" was —*

(a) LT Matthew Fontaine Maury.
(b) Vasco da Gama.
(c) An android character in the Star Wars trilogy.
(d) Portugal's Prince Henry, "the Navigator."

6. *Measured along a parallel, a degree of longitude always represents the same linear distance on the earth's surface.*

(a) True.
(b) False.

7. *When a freighter's cargo spilled in the early 1990s, 61,000 Nike shoes and 29,000 plastic duckies were dumped into the Pacific Ocean, and*

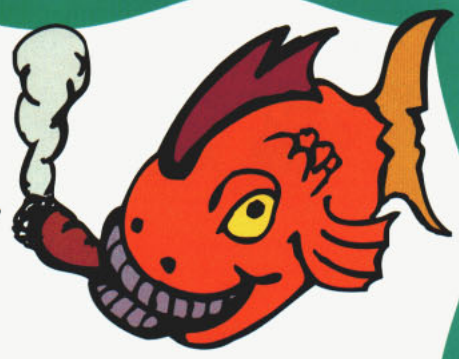
(a) They were distributed by the Navy to the poor after beach cleanups along the West Coast.
(b) Their movements were studied to "hind cast" drift and ocean current patterns in the Pacific.
(c) They were driven by winds and currents and eventually circumnavigated the globe.
(d) They were picked up by beachcombers and sold as souvenirs.

8. *Which of the following does NOT belong in the group?*

(a) The Gulf Stream.
(b) The Shamal.
(c) The Kuroshio.
(d) The Labrador Current.

9. *Normal ocean waves are fundamentally caused by —*

(a) The Earth's rotation.
(b) The tides.
(c) The wind.
(d) Geo-magnetic storms.



10. *The Oceanographer of the Navy is responsible for —*

(a) Military Oceanography.
(b) Operational Meteorology.
(c) Mapping, Charting, & Geodesy.
(d) Precise Time and Astrometry.
(e) All of the above.

11. *The difference between a "typhoon" and a "hurricane" is —*

(a) That a typhoon is bigger.
(b) The direction the wind rotates around the "eye."
(c) Whether you're in the Pacific or the Atlantic.
(d) How much it rains during the storm.

12. *The depth of the deepest point in the ocean is greater than the height of Mount Everest.*

(a) True.
(b) False.

13. *What percentage of seawater is "salt?"*

(a) About 1%.
(b) Around 4%.
(c) Around 10%.
(d) Greater than 15%.

14. *How far out to sea does a nation's Exclusive Economic Zone extend?*

(a) 3 nautical miles.
(b) 12 nautical miles.
(c) 200 nautical miles.
(d) 1000 nautical miles.

15. *How big was the highest wave ever observed at sea?*

(a) 50 feet.
(b) 90 feet.
(c) 112 feet.
(d) 165 feet.

16. *"Black Smokers" are —*

(a) Sulfate-rich hot water vents on the ocean bottom.
(b) Cigarette users with advanced lung disease.
(c) Arctic fog banks.
(d) A species of deep-ocean fish.

17. *The Beaufort scale is —*

(a) A device for weighing water samples.
(b) A special ruler used in navigation.
(c) A rare kind of fish skin.
(d) A way to describe wind speeds.

18. *Why is the North Star so useful for navigation?*

(a) It's fairly bright and easy to find.
(b) Its direction in space lines up closely with the Earth's axis.
(c) It has three easy-to-remember names.
(D) All of the above.

19. *Where are the highest tides located?*

(a) Cape Fear, N.C.
(b) Cape Canaveral, Fla.
(c) Bay of Fundy, Canada.
(d) Bay of Bengl, Bangladesh.

20. *What form of energy travels most efficiently in sea water?*

(a) Light.
(b) Sound.
(c) Radio waves.
(d) Heat.

21. *Which of the following is used from the orange roughy fish to make shampoo?*

(a) Scales.
(b) Oils.
(c) Bones.
(d) Ground fish powder.

CyberSailor

Oceans of Knowledge

Busted! I was sitting in the dentist's waiting room, for longer than I would have liked, when, in a moment of extreme boredom, I picked up one of those silly magazines for kids. You know the ones — filled with bright colors, short facts and tons of pictures. Well, as I sat there with this fluorescent symbol of youth clutched in my hands, a friend emerged from the office and took immediate notice. "Going for the intellectual stuff now, huh?" he asked sarcastically.

I quickly ditched the magazine, put on a rather sheepish grin and made excuses about boredom and the lack of good up-to-date sports mags as I waited anxiously for him to leave. Once he had gone, I gave in to an overwhelming urge to pick up the issue again. Why? Because I was having fun!

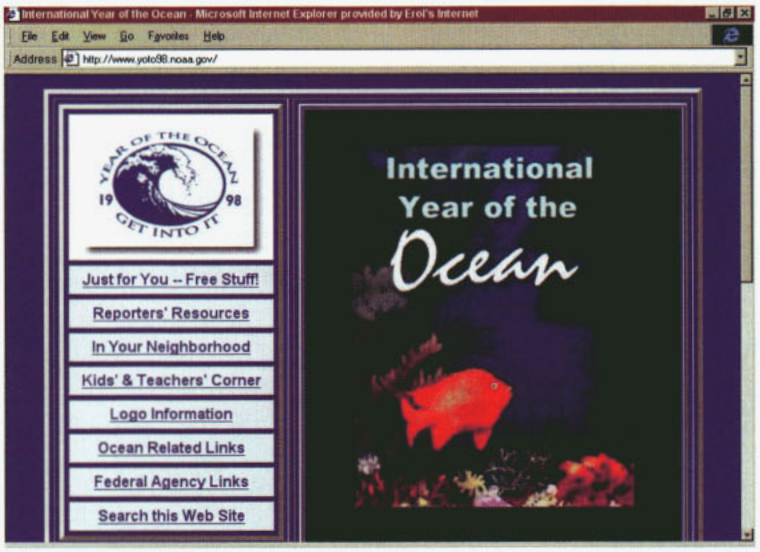
The magazine was all about the beautiful and dangerous critters living in the deep ocean. I was fascinated by these oddly shaped organisms — they looked liked something from a sci-fi flick — who reside in a world of complete darkness and extreme pressure. In a word, it was ... well ... cool.

This month, *All Hands* is dedicated to the Year of the Ocean (YOTO '98) and I decided it was a good opportunity to peruse the web for watery sites with information on the mysterious world beneath the waves.

A quick search for sites with the keyword "Ocean" brought 12,967 hits! Where to begin? A narrower search for "Year of the Ocean" gave me a more manageable 649 hits. After several hours of checking out more than 300 of these sites, I settled on a few that caught my interest.

I spent considerable time at the National Oceanic and Atmospheric Administration's (NOAA) web site dedicated to YOTO '98 (*www.yoto98.noaa.gov*). Here you'll find something for everyone. The official YOTO poster can be downloaded in .pdf (Acrobat Reader) format, along with fact sheets and brochures on the year-long observance.

The website has a variety of ocean topics, including coastal development and deep-ocean mining and exploration. Did you know that there are 3 to 500 million species living in the ocean? Or how about this... toothpaste gets its consistency from carrageenan, a product made from red algae. That same substance is also found in peanut butter, giving your favorite sandwich ingredient its speadability. Pretty cool, huh?



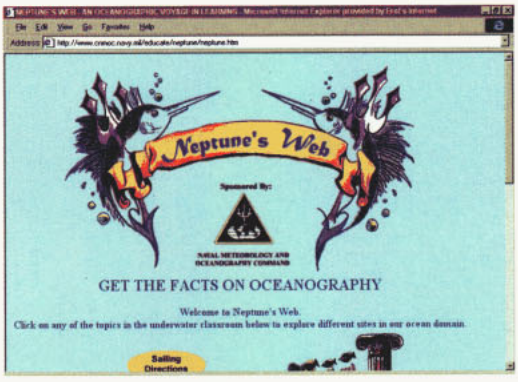
NOAA also hosts another site that anyone with a moderately fast connection will find entertaining. At *www.yoto.com* you'll find a page worth bookmarking. It includes a multimedia section with video clips on ocean subjects like coral reefs and the plight of the manatees. If you don't have RealNetwork's *RealPlayer* (required for viewing), there's a link to download the latest version.

The site also features a "Question of the Day" on topics relating to the ocean. On the day I visited, the question was, "How many miles of coastline does the United States have?" A click of the mouse (after considerable pondering, no doubt) reveals the answer to be more than 95,000 miles. You can also access past questions if you're in "Jeopardy" mode.

The official YOTO '98 homepage from the United Nations' Educational, Scientific and Cultural Organization (UNESCO) resides at *ioc.unesco.org/iyo* and offers the latest information on what's happening with the

YOTO observance worldwide. In addition to finding out how to order posters and flags (free of charge), there's also links to web sites dealing with almost any ocean category you can imagine.

Now I know military web sites can be ... uh ... a bit on the conservative side. But there are Navy webmasters out there designing some pretty cool sites. One in particular belongs to Naval Meteorology and Oceanography Command (NMOC). Type in *www.cnmoc.navy.mil/educate* and visit NMOC's educational material. Here you will find Neptune's Web, a treasure trove of information on the seas and oceanography.



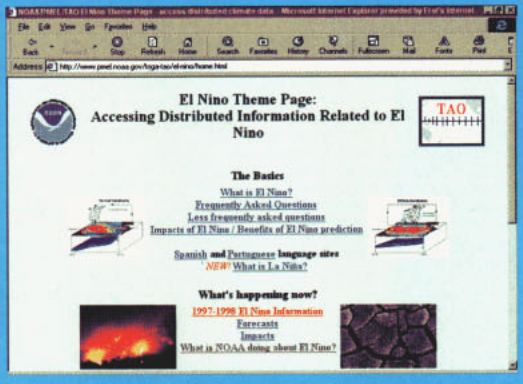
All of these sites have one thing in common with that magazine I read that day in the dentist's waiting room — the information is short and to the point. No digging through a bunch of text to get the facts on the only thing that covers the world better than the Internet — the ocean.

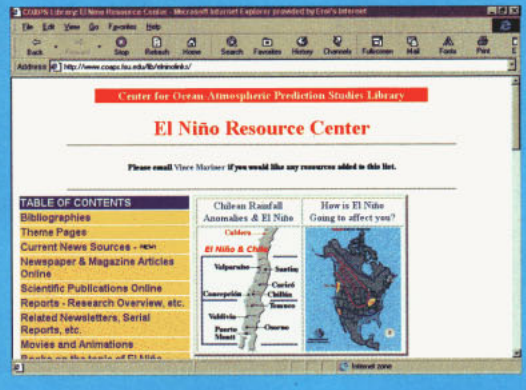
Blame it all on El Niño

What hasn't been blamed on El Niño? According to folks I've talked with, every weather condition, flu outbreak and car malfunction has something to do with this mysterious phenomenon taking place in the Pacific.

But what do you really know about El Niño? Warmer waters in the central and eastern Pacific seems to be the explanation on nightly newscasts. But a bit of cyber-research lets you know that there's a lot more to it than that.

For instance, El Niño reverses normal seasonal conditions in many parts of the world with significant impact on the environment, not to mention the economies of many nations. Check out the National Oceanographic and Atmospheric Administration's El Niño Theme Page (*www.pmel.noaa.gov/toga-tao/el-nino/home.html*) and you'll find the answers to all your El Niño questions. Within this site, you'll be able to access reports on the global and regional impact, plus an explanation of El Niño's colder sister, La Niña.





Looking for real evidence of El Niño's presence? Cruise over to Lowe's Storm98 El Niño page (*www.storm98.com/elnino*). Co-sponsored by the Federal Emergency Management Agency (FEMA), this site tells of the people and places feeling the brunt of El Niño's wrath. You'll find news reports and photos on storms hitting the west coast, as well facts on past El Niños.

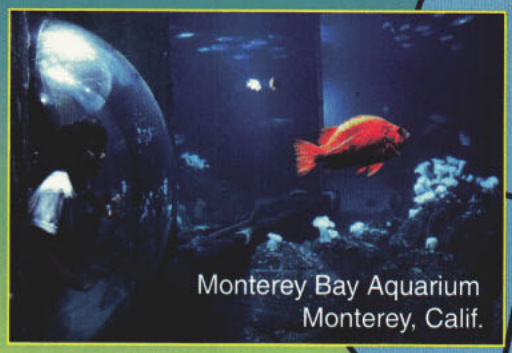
El Niño affects all of us in one way or another. It's grip on the world's weather (and our wallets) will continue for a while yet. These and other sites will help you discover what is really going on.

By the way, don't try explaining to your dentist that your ability to floss has been severely impacted by El Niño — it doesn't work.

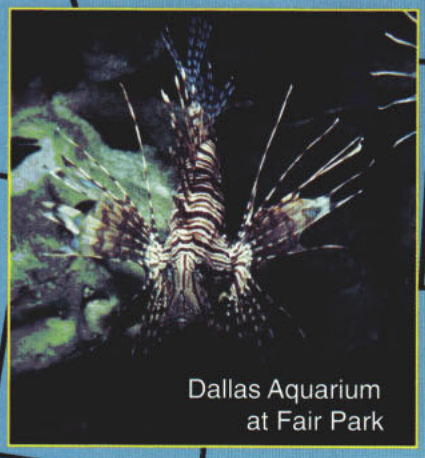
Go Exploring

Seattle Aquarium

Point Defiance Zoo and Aquarium
Tacoma, Wash.


Monterey Bay Aquarium
Monterey, Calif.

Minnesota Zoological Garden
Apple Valley, Minn.


Dallas Aquarium
at Fair Park

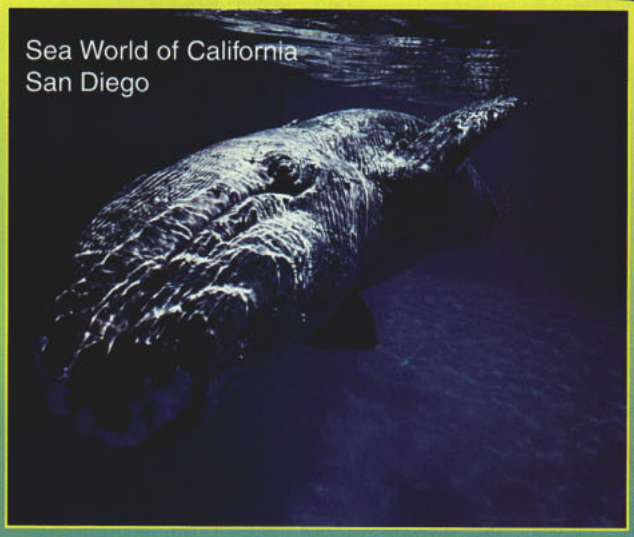

John D.

Omaha's Henry Doorly Zoo
Omaha, Neb.

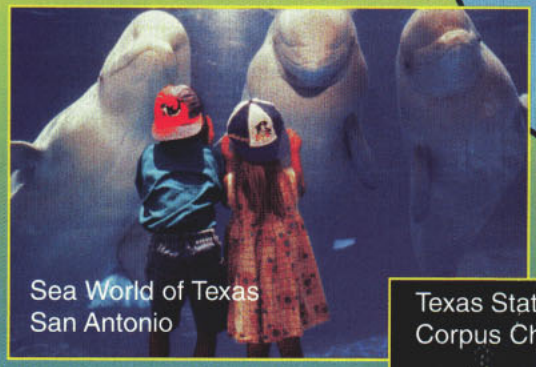
Steinhart Aquarium
San Francisco

Oklahoma City
Zoological Park
Oklahoma City

Albequerque Biological Park
Albequerque, N.M.


Sea World of California
San Diego

San Antonio Zoological
Gardens and Aquarium
San Antonio


Sea World of Texas
San Antonio

Waikiki Aquarium
Honolulu

Sea Life Park Hawaii
Waimanalo, Hawaii

Texas State Aquarium
Corpus Christi, Texas

Aquarium

Zoo\ Aquarium

National Aquarium
Baltimore

Ocean Fact

More than one-half of the U.S. population now lives and works within 50 miles of the coastline.

New England Aquarium
Boston

Aquarium for Wildlife
Conservation
Brooklyn, N.Y.

Belle Isle Aquarium
Royal Oak, Mich.

Pittsburgh Zoo
Pittsburgh

Mystic Marinelife Aquarium
Mystic, Conn.

New Jersey State Aquarium
Camden, N.J.

edd Aquarium
Chicago

Sea World of Ohio
Aurora, Ohio

North Carolina Aquarium
at Pine Knoll Shores

National Aquarium
Washington, DC

Indianapolis Zoo
Indianapolis

Columbus Zoological
Gardens
Powell, Ohio

North Carolina Aquarium
on Roanoke Island
Manteo, N.C.

Memphis Zoo
and Aquarium
Memphis, Tenn.

North Carolina Aquarium
at Pine Knoll Shores
Atlantic Beach, N.C.

Tennessee Aquarium
Chattanooga, Tenn.

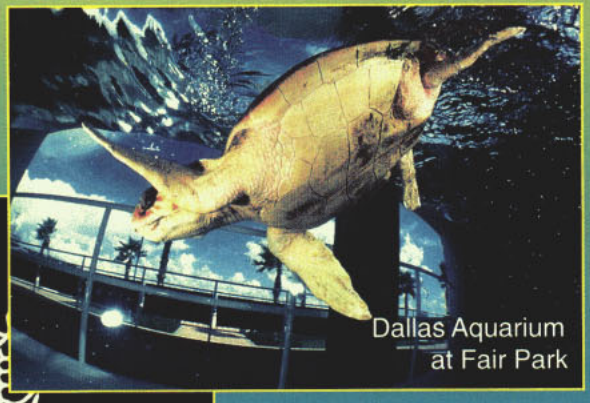
North Carolina Aquarium
at Fort Fisher
Kure Beach, N.C.

Living Seas
Lake Buena Vista, Fla.

Florida Aquarium
Tampa, Fla.

Aquarium of the Americas
New Orleans

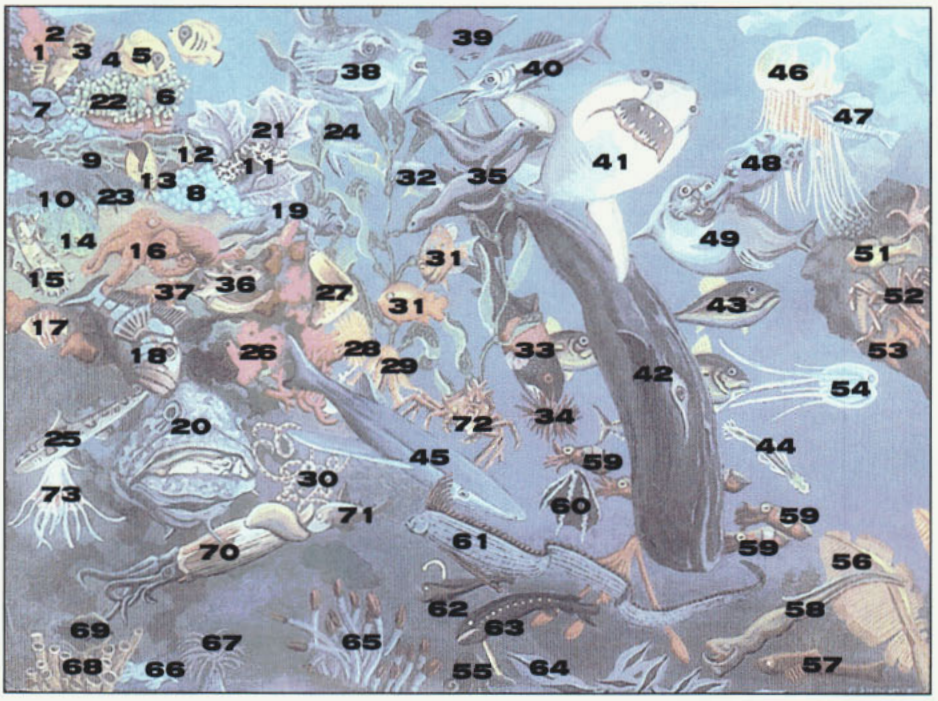
Sea World of Florida
Orlando, Fla.



Dallas Aquarium
at Fair Park

And the answers are ...

Check here to see how many sea creatures in the poster on Page 18, you named correctly.



Tropical or Reef Habitat:
1 Reef lobster
2 Star coral
3 Tube sponge
4 Gorgonian
5 Butterfly fish
6 Long-tentacled anemone
7 Brain coral
8 Boulder coral
9 Plate coral
10 Sea grass
11 Spotted moray
12 Butterfly fish
13 Rock beauty
14 Blue spotted ray
15 Spotted wobbegong
16 Common octopus
17 Butterfly fish
18 Nassau grouper
19 Marine iguana
20 Potato grouper
21 Purple sea fan
22 Common clown fish
23 Cortez garden eel

Temperate Waters:
24 Giant kelp
25 Leopard shark
26 Velvety red sponge
27 Vase sponge
28 Northern red anemone
29 Ochre sea star
30 Serpent star
31 Garibaldi
32 Striped jack
33 California sheepshead
34 Red sea urchin
35 Sea lion
36 Port Jackson shark
37 Troschel's sea star

Open Ocean:
38 Ocean sunfish
39 Atlantic manta
40 Billfish
41 Great white shark
42 Sperm whale
43 Yellowfin tuna
44 Arrow worm
45 Blue shark

Polar Waters:
46 Lion's mane jellyfish
47 Ice fish
48 Weddell seal
49 Ringed seal
50 Serpent star
51 Antarctic cod
52 Arctic sea spider
53 Bat star
54 Long tentacle comb jelly
55 Antarctic octopus
56 Gurney's sea pens

Deep Sea:
57 Sablefish
58 Gulper eel
59 Deep sea squid
60 Vampire squid
61 Oarfish
62 Viperfish
63 Deepsea dragon fish
64 Rift clam
65 Deep sea tube worms
66 Vent crab
67 Tube anemone
68 Tube sponges
69 Giant deep sea angler
70 Giant squid
71 Rat fish
72 Japanese spider crab
73 Deep sea jelly

Answers Ocean IQ

1. d - El Niño is short for El Niño de Navidad or "the Christ Child" because the warm water shifts happen around Christmas.
2. b - A bathythermograph provides temperature profile data (temperature vs. depth).
3. c - Tsunamis are incorrectly assumed to be caused by tides. Tsunamis are actually caused by underwater disturbances, such as an earthquake or volcanic eruption.
4. d - Since the architecture and chemistry of coral is very close to human bone, it has been used in bone grafts. It also helps human bone to heal quickly and cleanly.
5. a - (See story on Page 36)
6. False - It is true of latitude.
7. b
8. b - All except b are currents, the Shamal is a kind of wind storm.
9. c - Waves are primarily caused by winds, although earthquakes, volcanic eruptions and tides may cause waves.
10. e - Oceanography is concerned with knowledge of the oceans and improved technology based on that knowledge. Meteorology is the study of the weather and weather forecasting. Mapping, charting and geodesy deal with surveys measuring water depths, variations of the Earth's magnetic field, gravity anomalies and define the shape and texture of the ocean floor.
11. c - Hurricanes and typhoons are alike in origin, structure and features. The names given to each differ based on the area of the world in which they occur. Hurricanes occur mostly in the Atlantic whereas typhoons are found in the Pacific. Typhoons occur more often than hurricanes and are often longer and more intense.
12. True - The Marianas Trench is more than 7,000 feet deeper than the height of Everest.
13. b
14. c - The Exclusive Economic Zone refers to the coastal waters extending 200 nautical miles off shore.
15. c - Observed by the oiler *Ramapo* in the Pacific in the 1930s.
16. a - These hydrothermal vents, or fractures in the sea floor, spew sulfur compounds.
17. d - The Beaufort Scale was originally developed as a system for estimating wind strengths without the use of instruments.
18. d - The most well-known star in Ursa Minor is Polaris, or the North Star. Polaris is nearest the North Celestial Pole. If you stood at the North Pole, the North Star would be almost directly overhead. When you measure the angle of Polaris above the horizon, you can determine your latitude.
19. c - At certain times during the year, the difference between high and low tide in the Bay of Fundy is about 53 feet, the equivalent of a three-story building.
20. b - That's why sonar is the system of choice for finding submarines.
21. b - The *Hoplostethus atlanticus*, or orange roughy, is considered to be the fish with the lowest fat content. The oils extracted from the fish are used in making commercial shampoos.

Any Day in the Navy 1998

Any day of the week of May 4-10 is a typical day in the Navy. That's why it's so important to us.

Wanted are quality photographs that capture Sailors, Marines, Navy civilians, Naval Reservists and family members performing daily tasks, interacting with each other and/or otherwise contributing to mission accomplishment. The shoot has been extended to encompass an entire week to allow commands more flexibility. Selected photos will be published in the October 1998 issue of *All Hands*.

Photographs taken should reflect the diversity of both people and capabilities in the U.S. Navy and must be shot during the week of Monday, May 4 through Sunday, May 10, 1998. Photos depicting safety or uniform violations will not be considered. The best shots tend to be candid and unrehearsed, displaying the imagination and creativity of the photographer.

Submissions must include full credit and cutline information, including: full name, rank, duty station and phone number of the photographer; the names and hometowns of identifiable people in the photos; details on what's happening and where the photos were taken. Captions must be attached individually to each photo or each slide.

Photos must be processed and received (not postmarked) by *All Hands* by May 30, 1998. Photos will not be returned. Submit processed and mounted color slides, or quality color prints, either 5X7 or 8X10. Digital images will also be accepted. Just mail a zip disk containing the high resolution JPEG images with cutlines and photo credits embedded. Zip disks will not be returned. You may also download high resolution JPEG images directly to the News Photo Division of CHINFO by dialing (703) 521-1370 or (703) 521-1713. Mark all images as "Any Day Submissions."

Mail submissions to: Naval Media Center, Publishing Division, ATTN: *All Hands*, Photo Editor, NAVSTA Anacostia, Bldg. 168, 2701 S. Capitol St., S.W., Washington, D.C. 20373-5819.

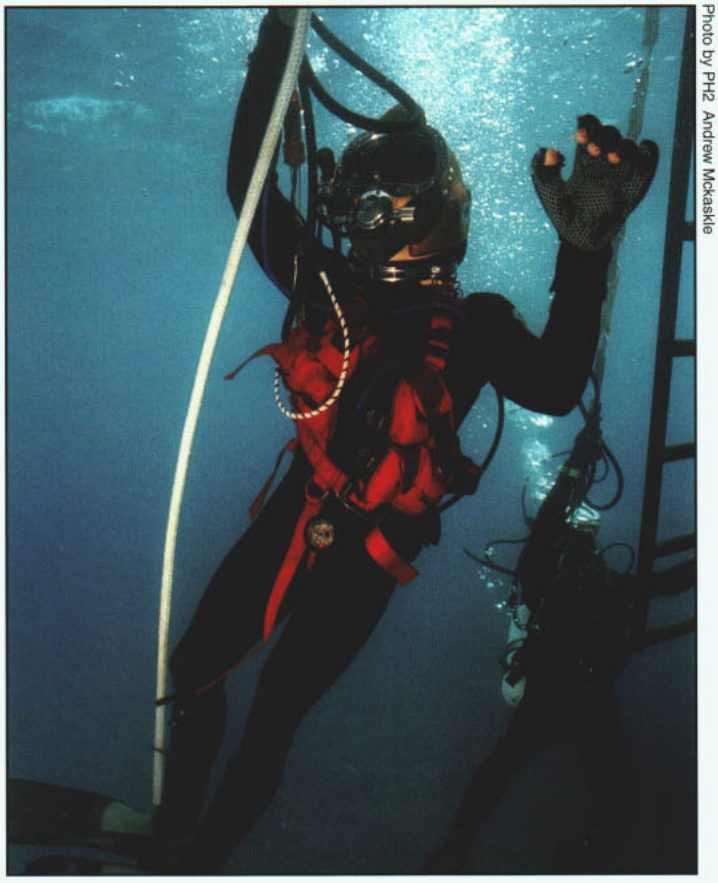


Photo by PH2 Andrew Mckaskle

Photocopy this form and attach a completed copy to each photo you submit.

Photographer:

Full name: _____

Rank: _____

Duty station (including mailing address and phone number): _____

_____

_____

Photograph:

Where photograph was shot: _____

Caption (what the photo depicts): _____

_____

_____

People in the photo (include first and last names, ranks/ratings, warfare designators and hometowns):

_____

_____

Photos by PH1 Dolores L. Anglin

Postcard from the Fleet

Name: Seaman Christopher S. Roath

Command: Explosive Ordnance Disposal Mobile Unit 3, Det. MK-6, Naval Amphibious Base Coronado, San Diego.

Hometown: Tampa, Fla.

Hobbies: Working out (weight lifting), soccer, football, swimming and scuba diving.

Favorite Duty Station: EOD Mobile Unit 3.

Favorite Quote: "Seize the day."

Key to Success: "Never give up, no matter how hard. Find out what you want and go full force to achieve it. If you work hard enough, you can get anything you want."

Goals: "I want to finish my degree in business and psychology, get my commission, become a SEAL and start my own psychology practice someday."